

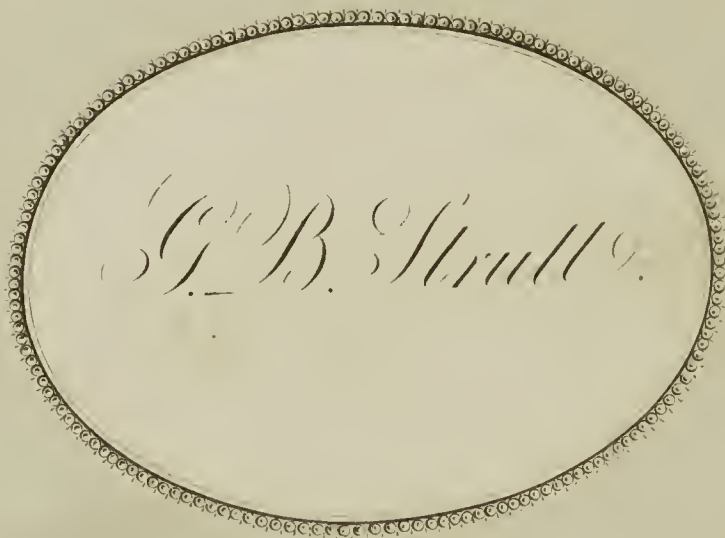


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LONDON, Printed for G. Smith, in Stanchope Street Clare Market.

LITERARY MEMOIRS

OF

GERMANY and the *NORTH*,

Being a Choice Collection of

E S S A Y S

ON THE FOLLOWING

INTERESTING SUBJECTS,

V I Z.

ALCHEMY,
ALGEBRA & ANALYSIS,
ANATOMY,
ANIMAL OECONOMY,
ARCHITECTURE,
ASTRONOMY,
CHEMISTRY,
CHRONOLOGY,

GEOGRAPHY,
HYDRAULICS,
HYDROLOGY,
LEVELLING,
LITERARY HISTORY,
LOGIC,
MANUFACTURES,
MECHANICS,

MEDICINE,
METALLURGY,
METEROLOGY,
MINERALOGY,
NATURAL HISTORY,
OPTICS,
SURGERY,
AGRICULTURE, &c. &c.

Done from the LATIN and HIGH-DUTCH,
By a SOCIETY of GENTLEMEN.

IN TWO VOLUMES.

VOL. I.

Illustrated with COPPER-PLATES.

L O N D O N:

Printed for J. WARCUS, the Corner of *Rackett-Court, Fleet-Street*;

AND

J. ROSS, at *Shakespeare's-Head*, in *Middle-Row, Holborn*.

M.DCC.LIX.

T H E
L I T E R A R Y M E M O I R S
O F
GERMANY and the *NORTH*,

CONTAINING many curious and useful Pieces, which, unless translated, in some such Collection, must continue unknown to the learned here in *England*, who are rarely acquainted with the *German* and *Northern* languages: We think the publishing this Work may be both agreeable and serviceable to the Publick. But as the same must be attended with a considerable Expence to the Publisher; we hereby recommend the Encouragement of it to such Gentlemen, as shall be desirous or willing to have the same carried on, without Prejudice to the Undertaker.

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TO
MARTIN FOLKES, Esq;
PRESIDENT,
AND TO THE
COUNCIL and FELLOWS
OF THE
ROYAL SOCIETY
OF
L O N D O N,
FOR
Improving NATURAL KNOWLEDGE,

This FIRST VOLUME of the

Acta Germanica

Is humbly dedicated by

Their most devoted and

most obedient humble Servant,

The EDITOR.

MAKING A GOOD USE
OF THE

COLLEGE AND HALLS

ROYAL SOCIETY

A. O. W. O. W.

Imperial University of London

in the year 1870

the University

of London

the year 1870

the year 1870

the year 1870

P R E F A C E.

THE Design of this Undertaking (of which now the first Volume is finish'd) is, to present the Reader with a Translation of what is deem'd most valuable and curious in the several Literary Memoirs, publish'd in different Parts of *Germany* and the *North*.

The Variety of curious and really useful Matters in the different Branches of Science which these several Memoirs contain, the Reputation they are in among the Learned, and those publish'd in the *German* Language being inaccessible to most Readers, seem Reasons sufficient to justify the present Undertaking.

But this Work is not confined to such Memoirs alone, as are publish'd in Sets of Volumes; it also takes in several curious and useful Academical Dissertations, publish'd in loose Sheets, which might otherwise be lost even to the Generality of learned Readers: And here it would be doing the Editor a particular Pleasure to mention some Gentlemen, who have not only encourag'd this Work, but have supplied the Originals of perhaps some of the most valuable Materials contain'd therein; as particularly, the Dissertation on the *Philosopher's Stone*, on *Camphire*, *Amber*, *Metallic Salts*, &c.

In the Execution of this Work Care has been taken to retrench no one Circumstance, that seem'd material to the Subject in Hand: Pompous Preambles, personal Addresses, Matters of mere Form, &c. have indeed been cut off, as what probably, the Original Authors themselves, were they in this Manner to publish their several Performances, would without Reserve have struck out.

The disposing the several Materials under general Heads might possibly be the more preferable Method; yet on several Accounts (which would be needless to mention) this could not be gone in to: However, to obviate in some Measure any such Objection, a particular

ticular Index is prefix'd to the Book, wherein the different Subjects are brought under general Heads, alphabetically ranged: Tho' possibly the other Method, that has been taken, may not be without its agreeableness with some Readers, as they may be pleas'd with an artless Variety.

As to the Names of Authors; they are cited in the Manner they generally occur in *English* Writers: But as to such as are rarely or never to be met with in these, the most eligible Way, one would think, was to call them by their *Latin* Names; as by these, it is presumed, they are best known among the Learned.

And now the Whole is submitted to the candid Judgment of the Reader: In a Work of such Variety and Compass, some Mistakes must be unavoidable; the Language may sometimes happen to be rough and unequal, owing to the Difference of Stile of the various Persons employed in the Translation, so that perhaps it was not always a very easy Matter to avoid these Blemishes: The over-critical and squeamish, indeed, may not only magnify such Escapes, but also imagine they discover Mistakes, where really there may be none: But the Candid and Judicious will be ready to extenuate and overlook such Miscarriages, if there is any Thing in the whole Performance that may atone for them.

It only remains to acquaint the Reader that the succeeding Volumes will with all convenient Speed follow this first, if the Publick by their generous Encouragement shall enable the Editor chearfully to go thro' so expensive an Undertaking.

I N D E X,

Wherein the several Subjects in this First Volume are brought under general Heads, alphabetically ranged.

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ACTA GERMANICA: OR, THE LITERARY MEMOIRS OF GERMANY, &c.

An Account of Storms of Hail and Thunder in different Parts of Europe; together with some historical Reflexions on Lightning. From the Breslaw Collection, An. 1717. Class IV. Article I. p. 62.

Translated from the High Dutch.



IN the month of July, in particular, *Anno 1717*, as there happen'd dreadful storms of hail and thunder in different parts of *Europe*, so it may seem no fruitless attempt to be somewhat the fuller in our accounts of them.

On the first of July, at *Hamburg* and the adjoining parts, the storm was ushered in about noon with a hurricane, which was accompanied with a peal of rain, dreadful thunder and lightnings, and with hail-stones of a prodigious size: The flash struck upon *St. Peter's* steeple, shatter'd the hand of the dial-plate in two different places, and split two beams on which the bells hung. A young lad,

Storms of hail and thunder at Hamburg.

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of about 14 or 15 years of age, who sat sleeping in a chair, was so stunn'd by the thunder-clap, as to become quite senseless, and it was some time before he came to himself again, and that with difficulty, and by the use of proper medicines.

The fruits of the earth, in these parts, were entirely destroy'd and beat down by the hail. In *Juliers*, about the same time, there also fell hail-stones of the bigness of hen-eggs.

At *Seidenberg*, on the borders of *Bohemia* and *Lausnitz*, not far from *Zittau*, on the second of *July*, about three in the afternoon, the thunder beat into the church in time of divine service, greatly shatter'd the gabel-end timbers, and beat down about 30 boards in both the corners, kill'd seven persons near the organ-loft, and hurt about 50 more.

July 2, not far from *Estampes*, near *Paris*, the hail did not only do a deal of damage, but the lightning kill'd a man and two horses; as the father and the son sought to shelter themselves from the hail under a waggon laden with wine, the lightning beat upon it, struck the father dead, and consum'd some of the butts. About the same time the hurricane did a great deal of damage on the sea-coasts of *France*, and in *Avignon*.

In the kingdom of *Naples* the rain, the thunder, and large hail-stones did considerable damage, especially to the grapes; and to avert these calamities public prayers were put up. At the same time this storm raged most violently near *Reggio* in *Calabria*, where the large hail-stones destroy'd all the country along the sea-coast for 20 miles together, kill'd upwards of 300 persons, and wounded a great many more.

On the 7th and 8th of *July* the hail greatly damaged the fields and gardens about *Warsaw*, near *Prasnick* and *Obory*. The hurricane beat down an alehouse in *Jezier*, by which accident several people were kill'd.

On the 10th, the lightning beat 60 times into *Choczim* in *Moldavia*, and laid several houses in ashes. On the 11th and 12th, by a dreadful storm of thunder and hail, the fruits of the earth and the vines suffer'd considerably in *Austria*, particularly about *Peters-Dorff*, *Medling*, &c.

About *Belgrad* on the 13th, between five and six in the evening, there was for two hours as dreadful a storm of wind, hail and thunder, as ever happen'd in the memory of man; it forced two ships from their fastenings to a bridge on the *Danube*, kill'd four horses, overturn'd into the river some baggage-waggons with their horses and oxen, sunk two barks laden with warlike stores and provisions, and drove from her moorings a *Turkish* galley of 18 guns.

On the 15th, near *Leipzig* there came from the west a terrible storm of thunder and hail, which lasted about half an hour, and chiefly raged for a mile and a half to the west of the town, and a mile to the east; the hail-stones were bigger than pidgeon-eggs, nay, many of them as big as hen-eggs, and beset with several points and angles; so that the windows to the

the westward were all broke to pieces, and their bars struck out, and the damage computed at about 1000 rixdollars: But the fruits of the earth suffer'd more considerably by this storm, being all irrecoverably beat down to the ground: It is here observable that the tract of this storm of hail did not extend above four foot in breadth. Eight days after, the like hail-stones fell at *Skeuditz*, two miles from *Leipzig*.

As on the 16th of *July*, the weather was very close and sultry (by which is not meant any remarkable degree of heat by the thermometer, but barely an uneasy sensation of it among animals, &c.) so after midnight there arose a violent storm of thunder, with a peal of rain, that continued at the same pitch for a whole hour: After this it abated a little; but about six in the morning it came on again still heavier, and then, which is observable, there was little or no wind stirring; the clouds were very thick and lowring, moving from west to east, and every moment threaten'd some terrible disaster: At times it rain'd a little; but all of a sudden there arose a dreadful storm of thunder and lightning, that beat upon the steeple of *Epperies* with a prodigious crash: At this time the *Author* was in his study, and he observ'd the flash come from the east in form of a fiery ball; and in this form it scarce continued a second of time, but sprung into a thousand pieces, and with a dreadful explosion fell upon the steeple, as above. This steeple is built four square and pretty high, and stands at the west end of the Church; after that the lightning had split one of the roof-timbers towards the east, and tumbled down some rows of tiles, and at the same time demolish'd the west side, and rent downwards the north wall, without endamaging the south side, it passed along an iron wire fastened to the hammer of a bell, and after breaking an iron wheel in the clock-work, it flew into the open air thorough the south dial-plate, and bent the hand outwards: Here again it ran down along another iron wire which came from the top of the steeple, and reached below to a little bell, and only left on the outside of the steeple a black spot, without burning a small cord fastened to the end of the wire; and after that, it passed over to the opposite wall, tore out a corner-stone, and made its way again thro' a small crevice into the concavity of the steeple; from whence it escaped thro' a lower window into the open air, and only left a brand behind it; but there was perceivable a strong sulphurous smell, and the iron wires were observed to be broken in pieces, and almost glowing hot. In the middle story of this steeple are hung those bells, which, according to the custom of this country, are usually rung in times of great storms: At a south window of this story, on which side the last mention'd wire goes down, and along which the lightning ran, stood a man, who was observ'd to drop down all of a sudden, and was suppos'd to be thunder-struck, but really was not; for, upon opening a vein he recover'd, without any perceivable hurt.

A Storm of
Thunder at *Epperies*.

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It is to be observed, that the end of the wire, to which the cord was fastened, rested upon the above-mention'd corner-stone, so that the lightning, after passing along the wire, must necessarily light on the stone: Now whether this was the reason of its entering the wall, or rather, by the end of the iron-wire, on account of a peculiar sympathy between iron and lightning, must be left to others to determine; tho' the latter seems more probable: For, in a storm of thunder, in 1673, the lightning ran down quite along the same wire, which then happen'd to be of a greater length, without the said corner-stone being opposite to it.

The Notion of
a Thunder-bolt
disprov'd.

From what has been said, it seems to be very evident, that what is commonly call'd a *Thunder-bolt*, is a mere empty conceit without any foundation in nature; since all the *phænomena* of lightning may easily be accounted for from the sole accension of a compacter sulphureo-nitrous matter: And he, who considers at the same time the power of the *phlogistic* matter in the fusion of metals, (of which Dr. *Stahl* has treated very learnedly) and the force of the sun-beams collected in the *focus* of a burning-glass, whereby gold itself is calcined; and how gold-smiths can in a moment, by directing the flame by the blast of a blow-pipe, melt down their metal; and in fine, how *Aurum fulminans* breaks in pieces, and that with a prodigious explosion, every thing that opposes it, may easily perceive, that we need not have any recourse to the notion of a thunder-bolt. So far this account.

Reflections on
Lightning.

As it is none of the least difficulties in nature to give a rational account of lightning, which is only to be deduced from the *phænomena*; and as these again, on account of many obstacles, are not so easily and evidently to be observ'd, so it will be the more necessary, carefully to set down all the historical *data*, that can possibly be collected, in order to a clear conception in this matter. It may, therefore, be no fruitless attempt to give a short abstract of the above-mention'd effects and *phænomena* of lightning, and subjoin it to these observations.

Nature of Lightning.

From the above relations it appears. 1. That lightning is a real, manifest, fiery substance. 2. That its matter is of the sulphureous kind. 3. That generally, and perhaps at all times, a greater quantity of igneous matter is set on fire than actually strikes, and that of this burning mass the most concentr'd part only comes down to the earth. 4. That from this we may probably infer, that not all such accended matter produces an actual lightning, but often times only a bare flash. 5. That lightning is an incomparably subtile and highly penetrating, active fire. 6. That one and the same particular lightning both rends and melts down bodies, and also burns them, as sufficiently appears by the brand. 7. That the power of lightning is greater in rending and dissolving hard and compact bodies, than setting them on fire, unless the subjects be very apt to take fire, as gun-powder, straw, hay, resinous wood, &c. to which effect probably the
burning,

burning, gross, fiery matter itself, that falls down, may contribute something. 8. When the matter of lightning is kindled at a greater height, it does not come down perpendicularly but goes off transversely, and spends itself aloft in the air; tho' it is not to be denied, but that the different positions of the clouds may contribute something to this diversity; as has been often observed, that when the storm has for some time continued to come directly downwards, at last its direction becomes oblique and transverse, and gradually the whole evanishes. 9. That the principal efficacy of lightning is owing to its motion, as in its velocity it exceeds all other things except light. 10. That lightning exerts its rending, penetrating, melting, and burning force according to its stroke on this or the other body; seeing, when it comes down unresisted on bodies, it does them no great harm, whereas things that stand in its way, and the place, where it first falls, suffer most. 11. That lightning, on account of its angular motion strikes with greatest force not only on high places, steeples, houses, and trees, but likewise readily both on compacter and rarer bodies. 12. That when it thus comes down on any thing, it often fastens on its whole extent, and even continues its course thro' narrow apertures, and this evidently refutes the notion of a thunder-bolt, and the above instance of the wire evinces it still further. And here we may alledge another remarkable and exactly similar instance, which happened at *Breslaw* in 1714, on *June 21*, about nine in the evening; at which time the lightning beat into *St. Elizabeth's* steeple, split some beams, passed thro' the false ceiling, and escaped out at the window; and it also fasten'd on the long wires, reaching from the place where watch is kept, and with which they usually ring for a signal a small bell that hangs in the sexton's house below; it actually broke in pieces one iron-wire, but pass'd along the other, without quite reaching the earth, into the open air in a right angle thro' a very small crevice; it passed directly over to about the distance of 40 foot into the sexton's house, where it split the wooden mantle-piece; and at last it got out into the open street thro' the opposite window. 13. That by means of this swift motion, and the concomitant expansive igneous force of lightning, the air is very violently divided and put into a great commotion; consequently, its gyri and rotations on the great number of thick clouds that pass along must necessarily cause a strong and continued sound, which, the more and the oftner it is reflected, the more violent is the thunder; as for instance, among ridges of mountains, in towns and even in houses. 14. That the receptacle of this matter of lightning is commonly thick clouds pregnant with rain, which, when they have discharged their stores, deprive the lightning partly of its *matrix* and partly of its fuel.

Some anatomical Observations on the Structure of the Biliary Vessels and Motion of the Bile. From the Acta Erud. An. 1682. p. 20.

Translated from the Latin.

The Gall-bladder communicating with the Hepatic Duct.

THAT the neck of the gall-bladder sends forth considerable branches, besides that mention'd by *Glisson*, the *Collegium Amstelodamense*, and *Blasius*, into the substance of the liver, or rather receives them from thence; nay, that some of these communicate with the hepatic duct appears by the following experiments.

Experiment I.
In an Ox.

In a bullock's liver it was several times observ'd, that upon blowing thro' the cystic duct till the gall-bladder was quite inflated, the wind passing thro' different parts of the concave side of the liver, return'd thro' the *ductus hepaticus*. It is true, this experiment fail'd two or three times in subjects, whose livers were stuffed with a calculous and tartarous matter; but in other sounder livers the event was more successful.

Experiment II.
In a Calf.

Upon squeezing all the bile out of the gall-bladder of a calf, and making a ligature on its duct, at its inosculation with the *ductus hepaticus*, to prevent the passing of any gall into the bladder, and then injecting warm water into the hepatic duct; part of this water passed into the bladder, remarkably distended it, and gush'd out at a wound made in it.

Experiment III.
In a Man, a Dog and an Ox.

Upon opening the cystic duct in a man, a dog, and an ox, at its continuation with the liver, I observ'd several orifices, which *Blasius* and those of *Amsterdam* observ'd only in an ox, as the mouths of so many biliary vessels; yet their number differ, as sometimes three in a dog, five in a man; and in an ox, sometimes a greater number, as twelve, and sometimes a lesser, as eight, and very lately five only; their course is sometimes longer, and sometimes shorter, and they generally penetrate pretty obliquely into the coats of the *meatus cysticus*; in a dog and a man, it is true, they are capable of admitting a probe: And hence they seem to be either the origin or insertion of peculiar vessels, whose progress could not be further traced by reason of their exceeding smallness: But in an ox, a subject, on account of its bulk, more proper for this purpose, besides the other *meatus's* of the cystic duct that run into the substance of the liver, two vessels of larger orifices arising from its opposite sides, and but slightly dipping into the substance of the liver, proceeded to the *sinus* of the *ductus hepaticus* in such manner, as to give the freest admission both to the probe and blow-pipe, from the neck of the bladder as far as the *ductus hepaticus*. In another liver, which was likewise that of an ox, there appear'd only one of these ducts, into whose orifice I injected melted wax, which, returning by the *sinus* of the *ductus hepaticus*, plainly shew'd the insertion of an intermediate duct, common to the cystic and hepatic ducts: And but slightly cutting into the substance of the liver, its branching

Plate I. Fig. 1.

ing

Fig. 1.

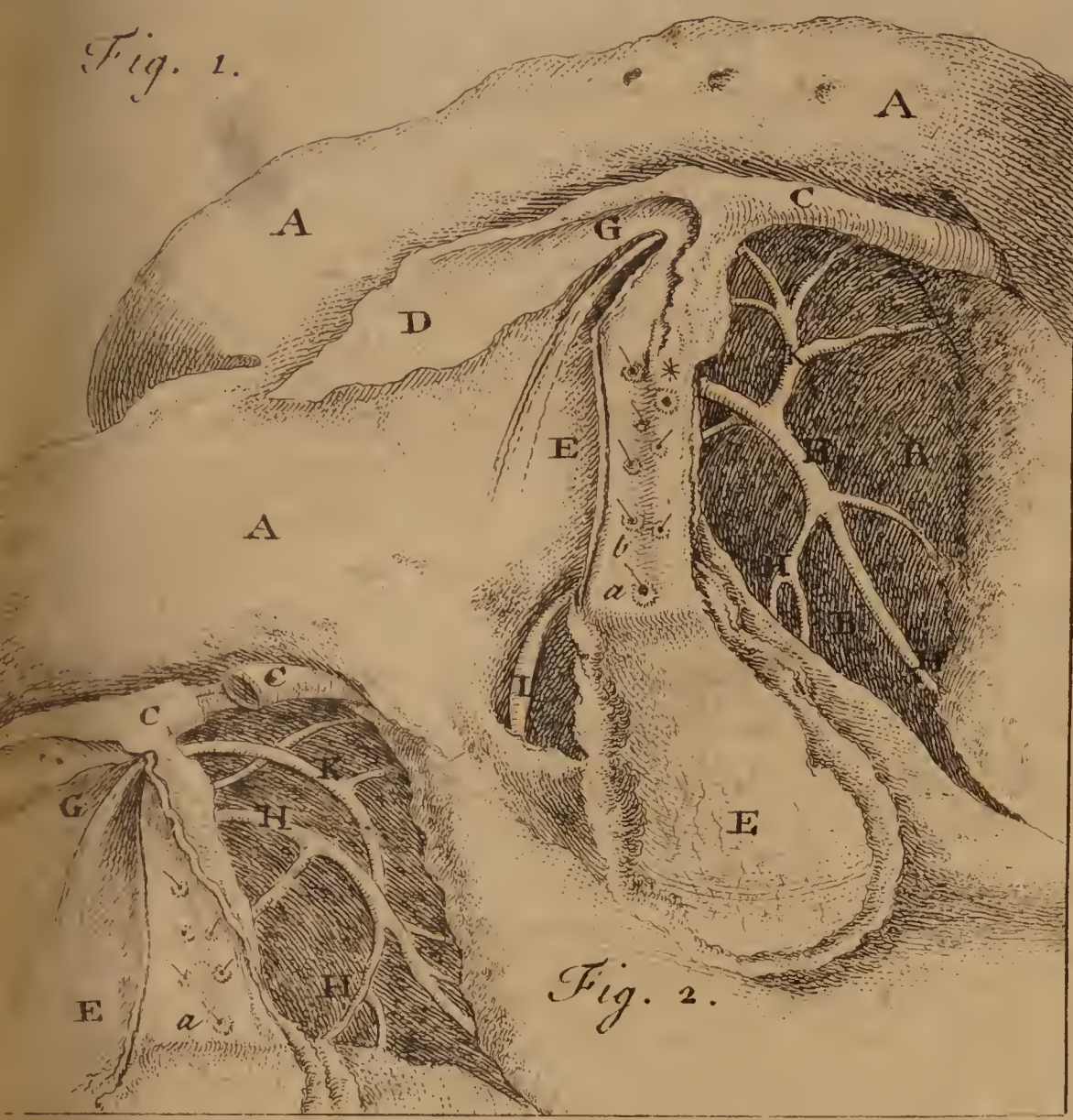


Fig. 2.

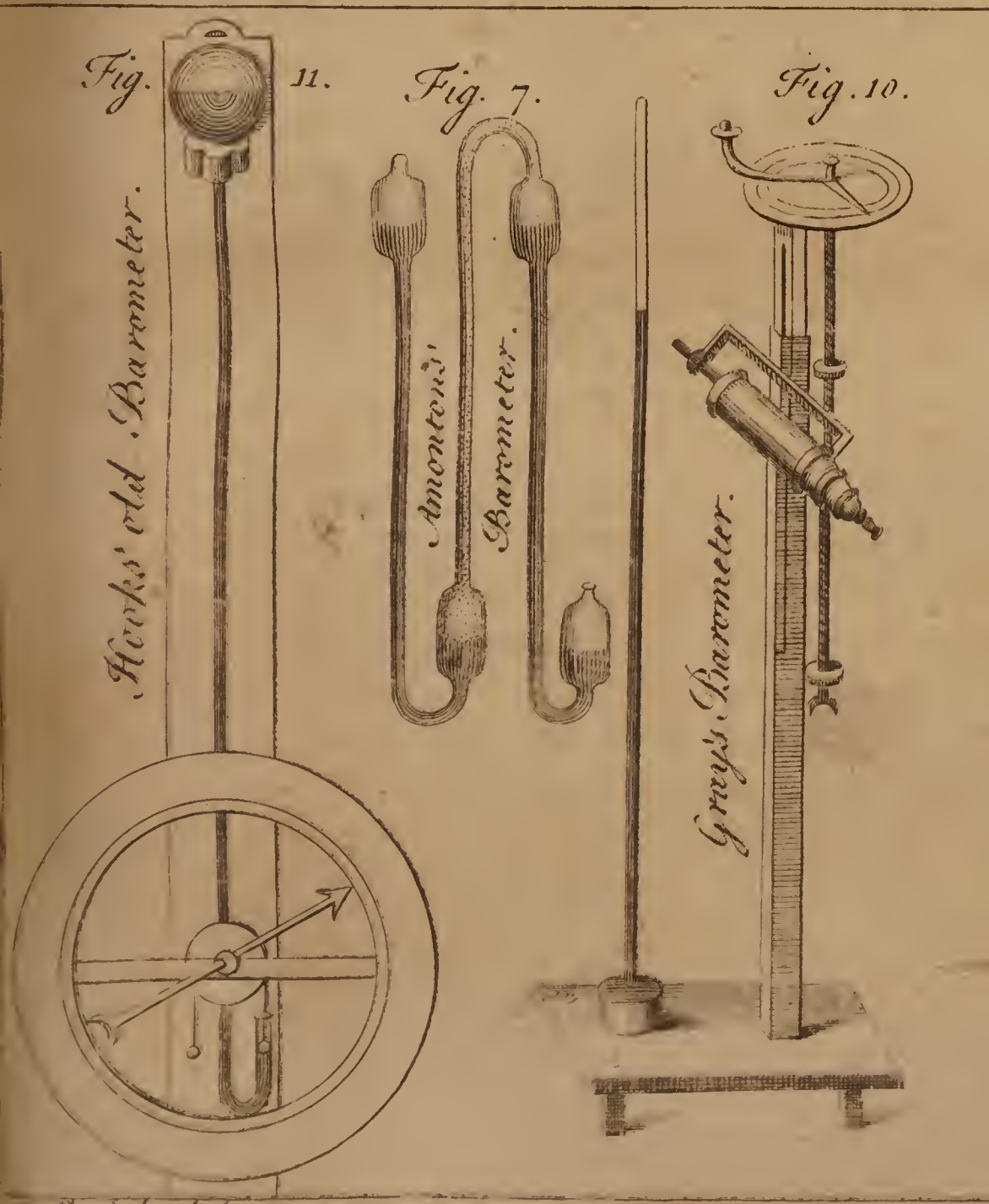


Fig. 3.

Carter & Huygen's former Barometer

Fig. 4.

Huygen's latter Barometer

Fig. 5.

Hook's and de la Hire's Barometer.

Fig. 6.

The Inclined Barometer.

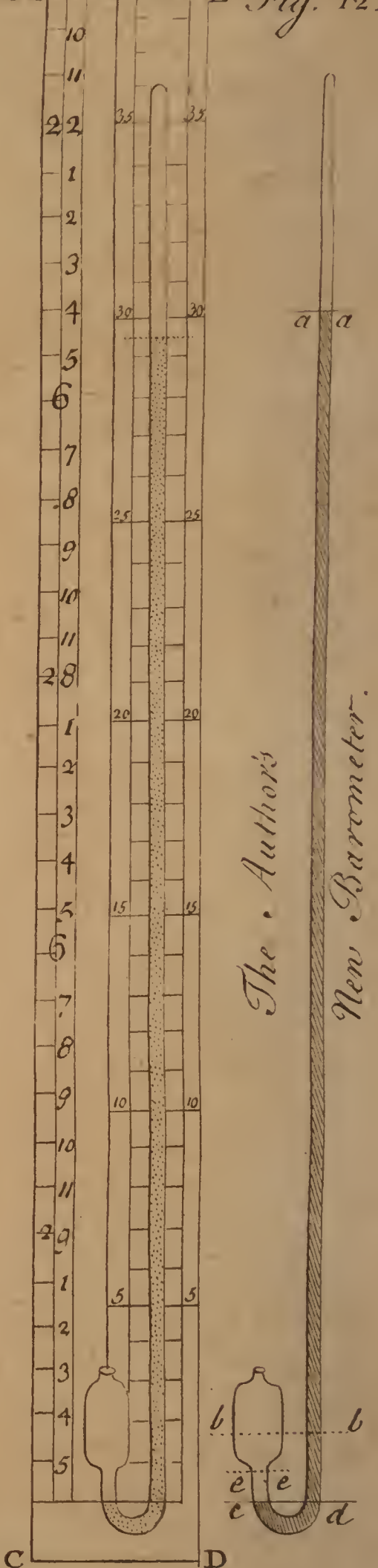
Fig. 8.

Bernoulli's Barometer.

A

B

Fig. 12.



The Author's

New Barometer.

Fig. 9.



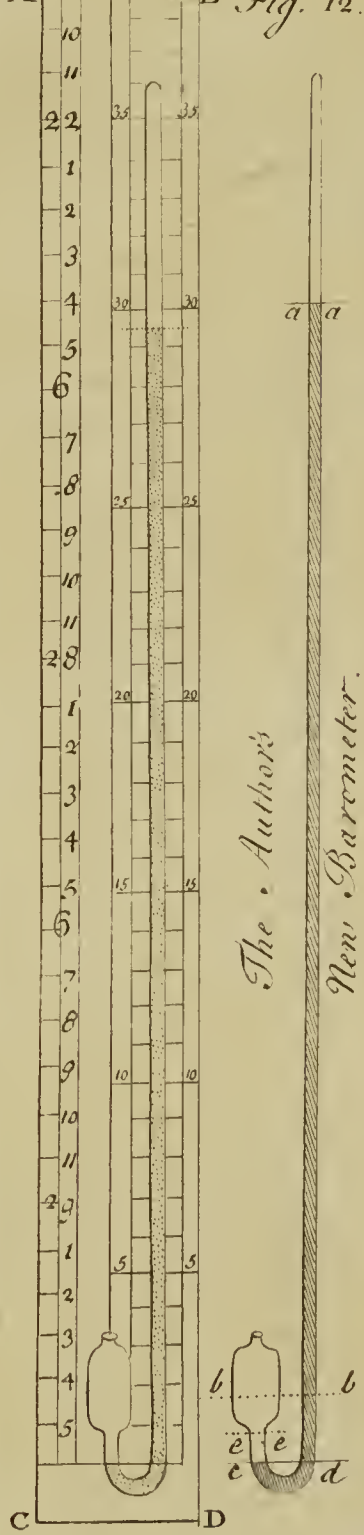
6.

Fig. 8.



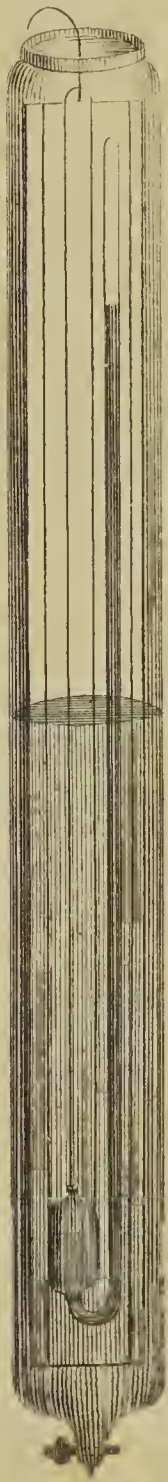
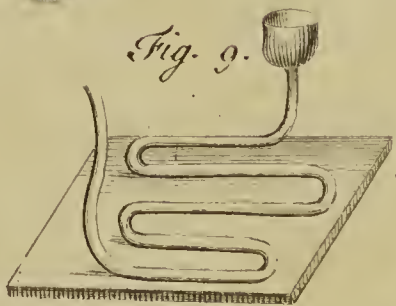
Bernoulli's Barometer.

A B Fig. 12.



The Author's New Barometer.

Fig. 9.



ing and its entire course presented to view, together with a remarkable branch tending to the hepatic duct, as likewise appears by the Figures. Whether this communication of the biliary canals be what is common and what universally holds, may indeed seem doubtful on the following accounts; namely, that as I complain'd above, I sometimes found no communication at all, and once only observ'd it double, but more frequently single: But as something of it is always observ'd in sound livers, I may probably conclude, that such a communication is no ways preternatural, tho' I frankly own, that it is sometimes greater and sometimes lesser; at one time single and at another time manifold; that now it enters deeper into the substance of the liver, and again only superficially; sometimes with more, and sometimes with fewer branches.

Fig. 1. and 2.

In *Glisson's* duct, at the neck of the gall-bladder, I observ'd that its structure and insertion are not always the same: Since sometimes I found two similar ducts adjoining to its orifice, which would admit of a probe, more rarely at the extremity of the bottom, and generally at the beginning of the *ductus cysticus*; nay, several times I could observe no trace of it, which I ascribe to the dimness of my sight; for, very lately in an ox it appear'd, that sometimes a *lusus naturæ* may happen in the ramification and insertion of this duct: For, tho' I made use of all the proper contrivances in tracing it, yet I could neither observe its orifice in the more usual places, nor its roots arising from the liver; till at length there appear'd a very manifest *hiatus* in the side of the *ductus cysticus* itself, thorough which injecting some wax, and slightly cutting away the fleshy parts, there presented to view a duct almost an inch long, and as thick as an ordinary writing pen, and furnish'd with several ramifications; which duct I may very reasonably suppose to supply the room of *Glisson's* duct.

Structure of
Glisson's Duct not
always the same.

What these things may contribute towards determining the motion of the bile, and the place where it is elaborated, which are otherwise pretty uncertain, I leave others, who perhaps have made a greater number of experiments, to determine: Yet that all the bile is not deliver'd from the liver into the gall-bladder, thro' the above-mention'd ducts only, but likewise thro' the *ductus hepaticus*, is confirm'd by the following observation, made on a live dog; I tore up the gall-bladder as far as the neck, to try whether any of the bile would run down thro' the neck towards the lacerated bottom: The event answer'd expectation; for not only did the bile, as in a flood, burst out from the narrower cystic duct thro' the wider neck of the bladder; but the cystic duct itself, after making a ligature on it, swell'd in such a remarkable manner, that little or no bile was afterwards deliver'd by the neck.

Experiment on
a live Dog, with
Regard to the
Bile.

AA. Represents the substance of the liver.

BBB. A portion of the liver where the fleshy parts are cut away.

CC. The *ductus hepaticus*.

Explication of
the Fig. 1. and 2.
Plate I.

D. The

- D. The *ductus choledochus communis* laid open.
 E E. The *ductus cysticus* laid open, as also the gall-bladder.
 * The orifice of the *ductus cysticus* and intermediate hepatic ducts.
 G. The communication of the said duct with the *ductus hepaticus*.
 HH. The intermediate duct with its branches, dispersed thro' the substance of the liver.
 K. A branch of this intermediate duct communicating with the hepatic duct.
 a. The insertion of *Glisson's* duct.
 I. A canal resembling *Glisson's* duct.
 b. Its orifice.

Of the different Sorts of more sensible Barometers, and of a new Kind of them and their Uses. By M. G. B. Bülfinger. From the *Commentarii Academiae Scientiarum Imperialis Petropolitanae*, Tom. I. An. 1726. p. 317.

Translated from the Latin.

An Account of
different Barome-
ters.

1. *D* Alencéus has in a particular treatise given an account of the origin and divers kinds of barometers: Few new ones have been added since that time; and yet there are some, and those worthy of the attention of the Learned. The principal care of the Inventors was to make the variations of the heights more sensible; for, to this, *Des Cartes*, *Hook*, *Huygens*, *Amontons*, *De la Hire*, and *Jo. Bernouilli*, have applied themselves: What *Amontons* chiefly regarded beyond the others was to distinguish by the effects of gravity what things are owing to heat, and to the expansion of the liquors. These great men were not disappointed in their attempts; for, we have many contrivances of theirs, yet some preferable to others: I myself have something on this head, which I shall submit to the judgment of the intelligent.

Two Classes of
Barometers.

2. I shall first treat of the barometers of others; and those, as far as they are come to my knowledge, I reduce chiefly to two classes. Some have attempted to render the variations more sensible, by the form or figure of the machine only; and others by using liquors of different specific gravities.

Water Baro-
meters.

3. If we should use water instead of mercury, and tubes of 33 feet, such as *Sturmius* mentions in his *Collegium curiosum*^a; the variations would in that case, it is true, be more sensible than they usually are in simple mercurial barometers: But who with patience could bear so unwieldy a height? Or who can purge the water of its air, so as that none of it may

rise

^a *P. II. Tent. V. p. 76. Seqq.*

rise up to the top? And who can reduce to rules the expansions of the water that are owing to heat? Yet its freezing may sometimes be prevented.

4. Such as with *Des Cartes* make the tube larger in that part, wherein the mercury plays in its rising and falling, and would pour water or oil upon it to indicate the variations in a narrower tube, cannot easily avoid the inconveniencies of the air that possesses its upper part; and both that air and the liquor itself are subject to variations arising from heat, which shall disturb the observation of gravity. *Poleni*^a, in this case, shews, that, by repeated inversions of the tube, the greatest part of the air may be expell'd as it rises out of the water; but whether the whole quantity of air may be thus exhausted, I shall neither positively affirm nor deny. It is certain, that this expedient is of great use, when we employ *Des Cartes*'s barometer; for, upon using it I scarcely think there remain any other sensible difficulties besides the influence of heat. We may easily reduce to rule the irregularities depending on the different heights of the fluid above the mercury; and at the same time note them in the scale of degrees: So that that correction of *Poleni* is entirely praise-worthy.

Des Cartes's Barometer.

Plate I. Fig. 3.

5. *M. Huygens*^b has avoided some of the inconveniencies of the former barometers by employing a double tube; but *De la Hire*^c has hinted at some imperfections that still remain in *Huygens*'s construction: *De la Hire* himself, by the same contrivance of a double tube, inflexed in the manner which *Hook*^d had used, has avoided or lessened most of the inconveniencies of the former barometers; and that by ingenious contrivances, tho' not entirely without their imperfections^e.

Barometers with double tubes by *Huygens* and *De la Hire*.
Fig. 4, 5.

6. *Amontons*, it is true, with another design, used a double tube; but by that very method he likewise render'd the variations more sensible, and entirely avoided some of the inconveniencies of former barometers. We read in the *Journal des Sçavans*^f a contrivance of constructing a barometer of 14 or 7 inches only; and upon filling the intermediate tube with any two liquors, we may render the variations much more sensible than in the simple barometer: I caus'd some to be made by the ingenious artist *Lucas de Coffa*, nor was I disappointed in the success; but it must be owned, that in the very structure of this barometer I met with difficulties, which every one cannot easily get over: So that it is not to be wonder'd at, that tho' the same be curious and elegant, and greatly commended in a particular treatise by an anonymous *French Author*^g, yet it is not commonly known nor described in the common *compendium*'s.

Barometers by *Amontons*.

Fig. 7.

7. This

^a *Giornale dei Liter. d'Italia* T. 5. p. 300.

^b *Journ. des Sçavans* An. 1672. d. 12. Dec. p. 173. Ed. Bat.

^c *Mem. de l'Acad. des Sciences* An. 1708. p. 207, 208. Ed. Bat.

^d *Phil. Transf.* No 185. p. 241.

^e *Herman. Phoronom.* § 324. & *infra* § 12.

^f An. 1688. d. 10. Maii.

^g *Act. Erud.* An. 1711. p. 319, 320.

The second Class
of Barometers.

Plate I. Fig. 6.

7. This is one class of barometers: Others have sought to mend the matter by the figure of the barometers only, and that in a twofold manner: Some have applied themselves to cause greater variations in the mercury; others again to observe at least more accurately the ordinary variations. The former was effected by those who inclined the upper part of the tube from the perpendicular to the horizon: This is an ancient contrivance, whose first author I know not; but it is found to be proposed by an anonymous author in the *Philosophical Transactions*^a, and is generally described by others: As it may be easily constructed, and as by increasing the inclination, it may be render'd somewhat more sensible, it, therefore, deserves commendation; yet it does not attain to the highest degree of exactness, and that on several accounts; as the increased frictions of the glass, the cohesion of the mercury, which hinders its running in narrower tubes, and makes it irregular in wider ones; the inconveniencies from heat become more sensible by the inclination, &c.

Jo. Bernouilli's
Barometer.

Fig. 8.

8. The best in this kind is undoubtedly that which we owe to *John Bernouilli*, and is explain'd in *Hermann's Phoronomia*^b; its upper part, where the variations of altitude are made, consists of a bubble of any degree of bigness; the tube at its lower part is incurvated, that it may run out parallel to the horizon; or which is more commodious in practice, it is reflected at pleasure upon a horizontal plane: The *Parisians* have hinted, that *Jo. Dom. Cassini* attempted such kind of barometers several years before; but that he afterwards laid aside this method, because the air insinuates itself into the mercury in a horizontal tube, somewhat wider^c.

Experimenton
Bernouilli's Baro-
meter.

9. I made trial of this, and found it succeed, when the diameter of the horizontal tube did not exceed a line; I was at first apprehensive of the inconveniencies of friction, that on account of the narrowness of the tube it would hinder the minuter variations: But I have learned by experiment, that they are not so considerable in a barometer accurately constructed; for, when, according to *De la Hire's*^d direction, I shook the barometer a little, I observ'd that the places, at which the mercury stood before and after the shake, differ'd little or nothing. The scale of the variations, in the one I first caus'd make, is seven times greater than the common scale. I shall give in a note^e my method of constructing these kinds of barometers, because

The Author's
Method of con-
structing these
Barometers.

^a No 236. p. 4.

^b § 324.

^c *Phoron.* l. c. p. 180.

^d *Mem. de l'Acad. des Sciences* An. 1712. p. 4. Ed. Bat.

^e ' Take a portion of a wider tube, three inches long; at one end let it be hermetically sealed; and at the other, by means of the flame of a lamp, let it be join'd to a slenderer tube of 28 inches in length: My instrument, it is true, on each side of the wider cylinder, has a slender tube; but you may easily perceive, that the upper one is not necessary: Let the tube, thus constructed and inverted, be fill'd with mercury to the height of one or two inches, with the same precautions with respect to the air, as are usually observ'd: After

because greatly different from those, propos'd by others, as that by *Jo. Bernouilli* in *Hermann's Phoronomia*^a, and by *Christian Wolfius* in his experiments^b, both because it is easy and accurate.

10. Dr. *Hook*, Mr. *Hauksbee*, Mr. *Gray*, and perhaps some others, have endeavour'd to make exacter observations of the variations, tho' not greater in the mercury, or the liquor employ'd: And they made use of two weights suspended to a thread about an axis; either of which should rest on the mercury, and the other hang freely; they fasten'd an index on the axis for designing the degrees of a circle, or any lesser divisions on a circular plate^c. But Dr. *Hook* himself hinted^d, that the event did not answer expectation; because the variations are indicated by fits.

Barometers by
Hook, *Hauksbee*,
and *Gray*.

Plate I. Fig. 11.

11. Mr. *Gray's* contrivance is elegant and accurate, if the instruments be made by a skillful hand^e. It may even be employ'd, whenever the height of the mercury in any tube is to be accurately observ'd; nor is it attended with any other inconveniencies than such as are common in the simple barometer; but by that very thing, it is far from that perfect sensibility we look for; and if the simple barometer doth not obey the minuter variations of the air, as all the Learned are agreed; in that respect, sure, an instrument, otherwise very ingenious, will disappoint the observers.

Gray's accurate
Contrivance.

Fig. 10.

12. After having rehearsed the several contrivances, hitherto propos'd by the Learned, we shall hint at those circumstances, in which they all agree.

Circumstances
in which the se-
veral Contrivances agree.

' After this take a new tube of such length, as something to exceed the space, which, in respect of its diameter and of that of the superior bubble, the mercury shall run over in its variation: Let the internal diameter of this tube be about a line, and let it be joined at the lamp to the former tube in the place where it is void of mercury: From the middle of the wider tube measure the mean height of the mercury, for instance 27 inches; and at this distance let the tube be so inflected at the lamp, that the one part may be perpendicular to the other: This inflected part, which is to be horizontal when the instrument is duly erected, (that it may not take up too much room, or easily swerve either upwards or downwards from the horizontal line) may again be variously inclined; and these inclinations, may, by means of some plane, be easily examined and rectified by the lamp. Upon inverting the instrument, the mercury, descending from the wider tube, will fill not only the remaining space in the vertical tube, but likewise a part of the horizontal tube, wherein it will afterwards vibrate: In joining and inflecting the smaller tubes, you are carefully to avoid the nodes and acuter angles, lest the impediments from friction be increas'd, as I remember happen'd in a like case: Moreover, from the given diameters of the wider tube and slenderer tubes, it is easy to determine the point of inflexion of the tubes, and the length of the horizontal tube: So that there may be no apprehension of the mercury being forced upwards from a heavier state of the air, or of its running out of the horizontal tube from a lighter state of the same; yet, by way of precaution, I bent upwards about an inch of the extremity of the horizontal tube; and to prevent any dust getting in, I again bent it downwards.'

^a l. c.

^b Tom. II. § 33. p. 63.

^c *Hauksbee's Exper.* Tab. I. pneumat.

^d *Phil. Transf.* No 185. p. 241.

^e *Ibid.* No 240. p. 176.

generally agree. 1. They all have this in common, that the top of the mercury may vary; and therefore unless the tube be perfectly equable (a thing not well to be expected) there are irregularities that arise from friction; and unless it be perfectly of the same width, there are others that are owing to a capillary tube: For, it is well known, that mercury does not rise to a level in somewhat narrower tubes; and that in the ratio of their diameters. Dr. *Jurin*^a justly complains of this inconveniency. 2. All of them are subject to disadvantages, from the diversity of the rise and fall of the mercury; which in the former case puts on a convex, and in the latter, a concave surface: And therefore, tho' at the sides of the glass it reaches to the same height; yet it does not indicate the same gravity of the atmosphere: And I am surpris'd, that this has never been objected to compound barometers. 3. The variations of all are disturbed by heat and cold, on account of the different and irregular expansions and condensations of the liquors. 4. All compound barometers are attended with the difficulty of knowing the diameters of the tubes, and that thro'out the whole length of the variation. 5. The necessary shake, mention'd above^b, begets oscillations no less incommodious in compound barometers than in simple ones. 6. And lastly; the difficulties of constructing are inseparable from almost all these barometers.

A new Barometer by the Author.
Plate I. Fig. 12.

13. I here give the world the design and structure of a new kind of barometer, which I lately hit upon, that I may be inform'd how near, or how far I am from the truth.

Its several Advantages.

14. I propose to myself a barometer, that shall indicate even the minuter variations of gravity; that shall be subject to no inconveniencies from the inequality of the tube, or from the diversity of the rise and fall of the mercury; that shall distinguish the expansions and condensations by heat and cold from the effect of gravity; that shall not require measuring the diameters of the tubes, and wherein the oscillations shall cause the least possible impediment; that shall not be affected by evaporating, foulness, freezing, &c. that shall be easily constructed; and in fine, that shall carry along with it the test of its own exactness.

Manner of its Construction.

Fig. 12.

15. For this purpose, take the common simple recurve barometer; mark upon it the place of the greatest height; and that either by observation, if such has been already made for some years past; or by the actual mensuration of the height of the tube: But take care that there be no more mercury in the tube and bubble than shall reach in the recurve part to the place *d*, at least three lines lower than the bubble *b*, when it rises to the greatest possible height *a*: But instead of the height *a*, you may take any other, something greater than that to which the mercury ever rises: So that the height *da* may be a small matter greater than any hitherto observ'd.

^a *Phil. Trans.* No 363.
^b § 9.

16. Let this tube be fixed to a brass plate ABCD, of a breadth not much exceeding the tube itself; divide the plate, beginning from the horizontal line cd , into degrees and inches, by parallel lines to cd ; make a groove in the plate for receiving half the depth of the tube; so that it may every where touch the divisions in the plate on each side of it.

17. Immerge the plate along with the tube in water, till the mercury touch the place a ; and note to what depth the tube is immersed under the water: I say if this be done, as the gravity of mercury to that of water, so is the height of the water above the line cd , to the depth of the mercury under the line a ; and this fourth proportional, subtracted from the whole height ac , leaves the true height of the mercury, at which in a given time it stands by the weight of the atmosphere.

18. The demonstration is easy: For, the mercury rises by the weight of the atmosphere and the incumbent water; deducting, therefore, the height arising from the pressure of the water, the remainder is equal to the pressure of the air. To avoid the trouble of calculation, I shall give an easy expedient in § 39. *infra*.

19. It appears, that this barometer is so much the more sensible than the simple one, by how much the liquor into which the tube is immerg'd is specifically lighter than mercury: And therefore, tho' its sensibility cannot be increased *in infinitum*, yet it may be increased to such a degree, as to answer the purposes of observations. Its Sensibility.

20. The specific gravity of the liquor to mercury may be independently investigated; for, if you consider what depth is requisite to make the mercury rise to the height of one inch, the ratio of the specific gravities will be the inverse of the said heights. Specific Gravity of the Liquor to Mercury investigated.

21. And that this may be accurately observ'd, you may employ a convex glass, simple or double, with or without threads, fixt to a plate in such manner, as to move upwards and downwards parallel to itself; for, by this means you may more exactly observe the limits of the mercury in the tube, and its agreement with the line of the plate, by which it is examined; and here Mr. Gray's contrivance, mention'd above^a, may be of service: Yet the use of a convex lens is easier. How it may be accurately observ'd.

22. It is a difficult matter, when the plate is immerg'd in the liquor, entirely to prevent the oscillations both of the mercury and liquor; yet two things may be of service in this case. 1. I could wish that the plate were suspended in a glass tube, sufficiently long and somewhat wide, that afterwards by means of a thread, pass'd round an axis, which is plac'd at the top of the tube, the tube might by means of a handle that turns quite round, and an endless screw, be gently, and without any violent shake, successively immerg'd into, or taken out of the water: For, in this manner the oscillations would be shorter. 2. If there is no hazard in delaying, Expedients to prevent the Oscillations of the Mercury and Liquor.
you

you may wait till the vibrations are over; but they will be sooner so than in the common simple barometers, from the resistance of the liquor in the other leg: If there is any inconveniency in waiting, note two or more successive oscillations; and for the true height, take the mean of the vibrations; and thus there will be little or no mistake, especially in estimating and transferring the height of the liquor; for instance, water, to the mercury: For, suppose you err in estimating the height of the water a whole line, after reduction it will not amount to the twelfth part of a line in estimating the height of the mercury.

Contrivances for
immersing the
mercurial tube.

Plate I. Fig. 12.

23. If any one is at a loss for glass-tubes of a sufficient length and width, he may of any materials make an oblong vessel, and cover its fore-part with glass-plates, whereby to observe the immersions of the mercurial tube. The bubble, or wider part of the tube, may be furnish'd above with a funnel, and below with a stop-cock, in order to shift the liquor at pleasure; but that part of the liquor in the small tube *db* may by means of a siphon be drawn off, whenever you have a mind to shift the liquors: For, there are some siphons, and those running spontaneously, into which the mercury does not enter, and by which all the water may be drawn off. And if you are also at a loss for such a vessel, the barometer may be immerg'd in any vessel full of water, and the depth to which it is plunged be noted: But in this case it is to be observ'd, that the top *a* is to be taken so as that in the experiment it be not plunged deeper under the water.

Advantages of
these Contrivances.

24. From what has been said it appears, that in this case there arises no inconveniency from the inequality of the tube; for, the mercury is always elevated precisely to the same height; nor from the diversity of the concavity and convexity of the upper surface of the mercury in its rising and falling; for, in rising it always acquires a convex surface; nor from the evaporating of the liquor; for, there is always a sufficient quantity of it; nor from the foulness of the liquor; for, the old may be shifted for fresh; nor from freezing; for, any liquor may be taken, and its specific gravity to mercury found out; nor from the mensuration of the diameters, which causes a great deal of difficulty in compound barometers, and that not only as to the abstract calculations, but likewise as to the execution in practice.

Farther Advan-
tages; together
with some Dis-
advantages.

25. I own indeed, that the actual measures cannot be taken with sufficient exactness by a pair of compasses; if they be taken for the liquors themselves, so as to observe how much space shall be run over in the slender tube, by the rise and fall of the mercury for one inch in the wider tube; for that whole space you shall have that degree of exactness, mention'd above ^a, in examining the gravity of the liquors: But you have by no means the same space for each part of the tubes, unless you suppose the tubes to be exactly equable throughout that space: But if you would examine by each line of the heights of the mercury the places of the liquor

in

^a § 20.

in the slenderer tube, it will be a tedious and endless work, and not always in your power: For, we cannot at pleasure have all the heights, except the greater ones, by the inclination of the tube; but this in a bubble is subject to many difficulties.

26. There is one difficulty, and that the greatest of all, which is, how the effects of heat are distinguish'd from those of the gravity of the atmosphere? Some authors generously overlook this difficulty, and take no notice of the disadvantages, and others palliate the matter; but *Amontons* is the only one I know of, who professedly treats of the affair.

One great Dis-
advantage.

27. Such as allow of *Amontons* correction of the simple barometers a, may easily apply it to my barometer, observing to make the line *cd* fall upon the middle of the bubble, fixt to the recurve part of the tube; and then they will have the common simple barometer, agreeing in every respect with the common barometers; nor will the expansion of the water, or any other liquor employ'd, be any hindrance to the success: For, by § 20 we may at all times discover its relation to the present state of the mercury; consequently, its present true height may be found in the same manner; nay, better and more exactly than if it was discover'd by the simple barometer. But having had the height of the mercury at that time, you may afterwards reduce it by *Amontons* table to the height of a hotter or colder mercury, employ'd at the time of construction.

Amontons Cor-
rection easily ap-
plied to the Au-
thor's Barometer.
Plate I. Fig. 12.

28. I sometimes thought, that the whole matter might be more easily and shortly thus discover'd: Suppose from *Amontons* definition^b, that the mercury in passing from the highest degree of cold to the highest degree of heat, is increased $\frac{1}{115}$ of its bulk; it is evident, if in its highest degree of cold it possesses the space *acd*, that in its highest degree of heat it must take up a greater space: But suppose its top at *a*, it would rise at least three lines above *d*; its expansion by heat, therefore, may be known by the height *ed* above *d*, and the same be compar'd to the whole space *acde*; and that either simply according to the length of these spaces *ed* and *acde*, if you suppose the tube sensibly, and in those respects, equable; or, if you would even take in the consideration of these niceties, by a more operose examination. Thus, therefore, the *ratio* of the density of mercury would be discover'd from one time to another; and consequently, the precise measure of the gravity of the atmosphere would at all times be determin'd: For, we should have the heights and densities of the mercury for any time.

Density of the
Mercury not dis-
cover'd.
Fig. 12.

29. *Amontons* opinion favours this method, when he hints^c that he learned by experiment, that the common tubes of barometers suffer no sensible contraction by cold, nor sensible dilatation by heat; and adding this consideration

Tubes of Baro-
meters, whether
affected by Heat
and Cold.

to

^a *Mem. de l'Acad. des Sciences An. 1704. p. 230. Ed. Bat.*

^b *Mem. de l'Acad. des Sciences An. 1704. p. 225.*

^c *Mem. de l'Acad. des Sciences An. 1704. p. 373.*

Plate I. Fig. 12.

Amontons Experiment not satisfactory.

to what has been already said, I see that nothing more can be wanting to reach our end: For, this can be the only difficulty remaining, namely, whether glass may be both contracted by cold and dilated by heat; and whether therefore, the increase of the bulk of the mercury is always greater in heat than the concavity of the little tube *ed*; it were, therefore, to be wish'd, that this other notion of *Amontons*, and his measure of the expansion, mention'd above ^a, were ascertain'd.

30. But I am oblig'd to own, that all my scruples have not been remov'd by his experiments: And I am persuad'd by experiments on the thermometer ^b, that the cavity of the tube may be enlarg'd by heat, as that is commonly inferr'd from the sudden falling of the liquor, when the thermometer is plunged into hot water: It will, therefore, be a thing made out, that the small space in *Amontons* experiment ^c, thro' which the mercury subsides, does not amount to the whole of the contraction of the mercury; for, even the tube was constricted by cold: The expansion and contraction of the mercury and spirits of wine are, therefore, greater than is determin'd by that place. You may, therefore, in like manner be apprehensive, lest in the other experiment, in which the increased capacity of the glass vessel was sought, the expansion of the contain'd liquor, made at the same time, shall exhibit the same less than the truth: But I would not obstinately insist on this; because the whole of that experiment is not describ'd.

31. You may easily judge; since this opinion of *Amontons* was so much to my purpose, that I left nothing untried, but rather wish'd to establish the same if possible; nor was I entirely disappointed. The tubes used for thermometers differ very much from the tubes of barometers in the solidity of their sides, and in their internal capacity: I did not, therefore, think it impossible to reconcile *Amontons*'s experiment with those made on thermometers.

Fig. 9, 12.
Amontons Experiment reconciled with those made on Thermometers.

32. For this purpose I took some slenderer tubes, but of a greater length, and I inflected them as in the Figure, with this view at least, that the longer tube might take up a shorter space. I furnish'd one end with the funnel *ab*, and directed the other into the capillary tube *cd*; and at the same time I pour'd a sufficient quantity of mercury into the funnel, that when once it should begin to run, no air might insinuate: because the air could escape thro' the orifice of the capillary tube, the tube was in a moment fill'd, and the mercury ran out of the capillary tube; till in the higher leg *be* it was in a level: Then the capillary tube was hermetically seal'd

^a § 28. ^b *Mem. de l'Acad. An. 1700. p. 153. and An. 1705. p. 101. An. 1710. p. 563.*

^c In the *French* Memoirs for the year 1710, we have the converse of the former experiment. I repeated both experiments, on occasion of a doubt arising about the true cause of the phenomenon, and in the presence of our Society, putting the *Florentine* thermometer alternately into hot and cold water, I found it answer as mention'd.

^c *Mem. de l'Acad. An. 1704. p. 225.*

seal'd at the lamp; so that no more air remain'd, than what the quickest eye could scarcely distinguish: The instrument thus prepar'd, I plung'd it alternately into hot and cold water; but I could not distinguish any sudden rising of the mercury in the cold, nor falling in the hot water. I examin'd the tube, whether any bubble of air, or the least particle of it, lay conceal'd in the hot water, but to no purpose. If any one cannot conveniently procure, or make a tube with a funnel, or hermetically seal a capillary tube, he may exactly enough close it up with cement, after he has fill'd it by suction; which is always easily done, and in wider tubes is almost necessary.

33. It therefore appears, that the method describ'd above^a, may be usefully employ'd: Yet this is not the only one; for, there is another, which I shall describe, in order to compare them both together, and which is the best, practice itself may determine: But there are two things necessary. First, at any given time to determine the height of the mercury above the level, which, by means of the liquor, may be thus exactly done.

Another Method of discovering the Density.

34. Plunge the barometer till the mercury reach the line *a*; and in the annex'd scale of divisions note the height of the liquor above the line *cd*^b: If in this case the mercury be rais'd above the line *cd*, plunge it farther; if depress'd below *cd*, draw out the tube till the mercury exactly answer to the line *cd*; examine what each of these heights, according to the specific gravity of the liquor, defined above^c, does make, when reduc'd to the heights of the mercury: Then to obtain the true height of the mercury for that time above the level in the other tube; in the former case subtract, and in the latter add the last height to the first: I here neglect the height of the liquor *ed*, as being inconsiderable; but if you would not, it is easy to take it into the account too: For, it is sufficient to take it barely by the eye.

Plate I. Fig. 12: How to determine the Height of the Mercury above the Level.

35. Thus we obtain the first: The second requires, that you likewise know the present density of the mercury; proceed, therefore, thus: If the water, or any other liquor employ'd, were always of the same density, the present density of the mercury to the past might be discover'd by § 20. But as this does not hold of any liquor; by the method § 20 we only discover the mutual density of the mercury and liquor, at every time: But for our present purpose, there is still something more requir'd, to wit, that the density of either at different times be mutually compared; for, thus if you can exactly compare the density of warm mercury with that of warm water at the same time; and the density of warm water with that of cold water; and the density of cold water with cold mercury at the same time, you may likewise, with the same exactness, compare the density of the mercury warm at one time, with the density of the same mercury cold at another time.

To know the mutual Density of the Mercury and Liquor, and how to compare them.

36. The

^a § 28. ^b § 17 *supra*. ^c § 20.

To compare the
different density
of water at diffe-
rent times.

36. The first and third may be done by means of § 20; but the second is still wanting: And thus, at length, the whole difficulty is reduc'd to this, namely, to be able to compare together the different density of water at different times. This problem has been long, and that differently resolv'd by many: I chuse to pitch on that method, whereby a solid body, as metal, for instance, is carefully weigh'd in both waters; and from the weight it loses, the density of the liquor is determin'd. To obviate an objection, to wit, that the metal itself may be contracted by cold and dilated by heat; you may take it at a mean state, wherein it neither greatly exceeds nor greatly falls short of the ordinary heat of one's hand, for instance.

The Author's
machine both a
baroscope and a
barometer.

37. And thus, at length, I think I have, by three easy operations, reduc'd a problem the most difficult in itself to one of the easiest: And therefore, if naturalists allow, that there are such things as areometers, they may also grant, that this machine of mine, after separating the effect of heat from gravity, is not only a baroscope, but a barometer; by which we may not only distinguish the variations of gravity in the atmosphere, but likewise measure them.

In this barometer
the error from
heat and cold less
sensible than in
the simple.

38. I add this one thing, that if one does not require the greatest degree of exactness, what has been said § 28 may suffice; or even employing, instead of the other liquor, oil of tartar *per deliquium*, whose rarefaction is said not to be considerable^a, the operation § 35 may be omitted: For, the error arising from heat, as the calculation easily shews, premising only the operation § 20, will be but little sensible; nay, even if the liquor were very subject to expand, as for instance, spirits of wine; then even neglecting the precaution § 20, and employing only the operation § 34, the error arising from heat and cold will be less than in the simple barometers: And therefore, as one aspires to a greater degree of exactness; so by a greater number of precautions he may arrive thereto.

How this barome-
ter may be ren-
der'd more com-
modious.
Plate I. Fig. 12.

39. But the daily use of the barometer may even by this small contrivance be render'd more commodious; if from the one side, and that from the horizontal line *cd* be number'd inches and lines, beginning from unity, but number'd from the other side in such manner, that the inches of the height of the mercury, suspended by the atmosphere, be set down to those places wherein the water shall stand above the tube, and the intermediate space be divided into 12 greater parts, each of which may answer to the lines of the mercury; and being again subdivided into 12 parts, may indicate the duodecimals of the lines. This shall suffice when it is not necessary to attend to the heat; but when it is, you will not begrudge the using greater diligence by following the directions, §§. 33, 34, 35.

To make this ba-
rometer portable:

40. The only difficulty I have not hitherto consider'd is, whether this barometer be also portable: And it is such if you please; for, if by a portable barometer we mean such as may on any occasion be safely convey'd from

from one place to another; simple barometers, especially the recurve ones, are reckon'd portable: Take my barometer out of its liquor, and inverting it you shall have the simple recurve barometer: If you are apprehensive that the water which stagnated in the bubble shall enter into the other part of the tube (tho' this may be prevented, if the tube be narrow, and if there be such a quantity of mercury, as that it cannot all enter into the longer leg) you may by § 23 first draw off the water by a capillary recurve siphon.

41. The following method is more commodious: Leave the mercurial tube with its plate in the other wider tube, if the lower bubble be of such a width, that the mercury vibrating by the shaking in the carriage, may not run out in its fall, and the tube from the bubble be at its inflexion of such a length, that should the mercury rise to the top, yet it may not retire quite to the inflexion of the tube; in this manner may you carry the barometer erect.

Another more commodious Method to make it portable:

42. But if you would rather carry the barometer inverted or inclined, and that lest the top of the tube should be broke by the shaking of the mercury in its rising; let the tube be twice inflected at its lower part, and let the mercury, when it rises to the top not retire beyond the first leg: All which may be easily done.

How to carry the Barometer inverted or inclin'd.

43. I take it to be no difficulty, should any one ask, how the plate ought to be suspended, so as that the leg of the barometer may be perpendicular: Let the line of suspension pass through that common center of gravity of the plate and tube, which happens when the plate is half immersed; for, you may safely neglect the differences of that centre of gravity, on account of the inequality of the sides of the tube, which easily varies according as it is more or less immersed. But if you require the utmost exactness, fix a plumb-line to the plate; and thus fasten the instrument to the wall, that the plumb-line may design a line parallel to the axis of the mercurial tube; which line must be first described. Let this suffice for the structure of my new barometer; to which I shall over and above, add this one thing.

How to suspend the Plate.

44. If you do not require, that the barometer distinguish heat from gravity, but yet be more sensible than the common and simple one; and be without some of the defects of the simple barometer^a, and be easily constructed; all this may be done in the following manner: Let two plates be join'd together at right angles, yet so that the one shall remain fix'd, and the other turn round an axis, and in its rotation graze on the other: To the revolving plate fix the simple barometer, but much bigger than the common one, and furnish'd above with a ball, if you so incline, but of a narrower tube; in that tube take some point, as for instance, at the height of four foot from the lower bubble, which is full of mercury; at a greater or lesser distance, as you want your barometer more or less sensible;

How to make this Barometer more perfect than the simple one.

C 2

but

^a § 12. n. 1. 2.

but then let the moveable plate with its barometer be inclined, till the mercury reach the above-mention'd point, and observe the magnitude of the angle, comprehended between the inclination of the tube and the horizon: For, if this angle be greater, the gravity of the atmosphere is greater, in the ratio of the sines of the angle of inclination: It will not, therefore, be a difficult matter to construct a scale on the immoveable plate, which may exhibit the height of the mercury in common measures: And thus we have a new structure of a barometer, which notwithstanding I think inferior to the former.

Uses of the more
sensible Barome-
ters.

Whether they
foretel the Wea-
ther.

45. My opinion on the subject of the uses of barometers, is much to this purpose: Tho' barometers do properly indicate only, and not foretel; yet hitherto they have been chiefly employ'd to prognosticate the weather: But as these predictions are often fallacious, the instruments came to be blamed; just as we usually blame our senses, when precipitate judgments about the senses deceive us: Corrections therefore, have been sought, but there are no other than making the changes more sensible, and freeing them from the irregularity of heat and cold: So far indeed well; yet it contributes nothing to foretell the weather: We observe, that we do not always attain to the sensible differences of weather, even at those variations of the mercury, which are easily distinguishable in the simple barometer; nor can they, therefore, be probably predicted from still lesser variations. For this end, therefore, I am of opinion, that these more sensible barometers cannot be *immediately* applied.

46. Yet probably, this may some time or other be *mediately* done, if one could hit on the method of discovering the successions of the winds from the variation of gravity; for, on these the great variety of the weather depends. But indeed the rise and effects of winds are more compounded, than that barely from the gravity of the atmosphere, the knowledge of these successions can be drawn: And it is even a question, whether from knowing the state of the atmosphere by several instruments, which indicate the other properties of the air, a probable conjecture may be made on the wind or future state of the atmosphere.

Greater Heights
whether discover-
able by them.

47. I have, therefore, thought proper to assign this use, namely, that by means of a more sensible barometer, a more accurate scale of the variation may be had according to the greater or less height of a mountain and depth of a mine; with the view to find, whether perhaps by assuming these differences, known by observation, as the elements of a geometrical *locus*, some certain rule may not be got even for greater heights than can be obtain'd by experiments. For this end such observations are necessary, as have been made in convenient places, as on the tops of mountains and at the bottoms of mines: But care is to be taken, that those heights and depths be obtain'd by actual mensuration, and not by a calculation made from angles alone, and one station actually measur'd: As also, that we do not here fall

into

into a paralogism; for, since on account of the fallacies of vision arising from the refraction of the rays of light in judging of heights, barometers are sometimes made use of to measure the heights of mountains, it is manifest, that the heights known in this manner do not at all answer our purpose.

48. There may likewise arise a scruple, whether or no the rays of light passing through the atmosphere suffer a greater or less refraction in different states of its gravity? For, the air is heavier, either on account of its increas'd height or density, both which vary the quantities of refraction; the one on account of the longer way of the refracted ray, and the other on account of the greater angle of refraction: It is, therefore, a question, whether that variation of refraction, if any, arising from the different gravity of the atmosphere, be sensible by observations and experiments carefully made? and whether it be of any consequence in Astronomy?

The Rays of Light whether affected by the different State of the Air.

49. In order to discover the ordinary course of nature in passing from one degree of gravity to another, and to observe the varieties of gravity depending on the winds, as also on one or more clouds in the horizon or vertex, *Caswell's* new baroscope^a may be used with advantage, being more sensible than, and preferable to all others, could we therein either avoid or distinguish the effects of heat and cold: and therefore could this be done, it would be a thing exceedingly praise-worthy.

Caswell's new Baroscope, and its Use.

50. As to my correction of the barometer I may say in particular, that it may serve for finding the specific gravities of different liquors at the same time; for verifying *Amontons's* opinion, mention'd above § 29; for determining the measure of the contraction of tubes, if there be any such thing, and what proportion it observes, &c.

Use of the Author's Correction.

Of the Ignorance of the Human Soul as to its own Nature, the particular Time of its beginning to exist, the Manner of its Union with the Body, &c. Being a Dissertation deliver'd in the University of Leyden. Anno 1740. By M. Peter Van Musschenbroek.

Translated from the LATIN.

THAT the Soul, infused by the Supreme Being into the human body, is the source, the cause and organ, as it were, of all human knowledge and intelligence, every one will easily allow, who with even the least degree of application shall attend to himself, his measure of knowledge, his thoughts, and his operations: For, we find that whatever is merely corporeal, is of itself inert and unactive, destitute of all knowledge and life, and unfit either to acquire or form any conceptions of itself or of external things; but on the soul alone are confer'd the most excellent powers, and

The Soul the Cause, &c. of our Knowledge.

and the unvaluable endowment of understanding the things in this universe.

Its great Capacity, as to external Objects.

The soul, therefore, furnish'd with its faculties, does not only on all sides examine the body, with which it is very closely united, but expatiating, as it were, beyond itself into the remotest regions, makes researches into the whole system of bodies on our globe: Nay, taking a higher flight, it also pries into those bodies, which revolve and twinkle in the wide expanse of heaven; sedulously investigates their properties, motions and periods; forms various judgments about them; reasons subtly and with penetration upon them; and in fine, in various manners enters deep into the knowledge of them. Now if the soul acquires no ordinary degree of knowledge about things, remov'd to the greatest distance, will any one venture to infer, that it shall not know its very self much better, and with greater clearness and penetration? Since by being always intimately present to itself, it may with the greater ease examine itself, and viewing itself, as it were, with its own eyes, thoroughly pry into its own inmost recesses, contemplate itself on every side, explore all its own faculties, discover all its own operations, and their manner of acting.

Yet ignorant of its own Nature, and why?

At first blush this might seem to be the case; but to a more diligent enquirer, alas! what a degree of ignorance and what darkness immediately present themselves to view! So that we are rapt into the greatest admiration, or rather pain, when we find, that this intelligent being, not entirely unacquainted with external things, is notwithstanding so ignorant of its own self. The case is this, the soul is so closely confined to a narrow prison, and that in the thickest darkness, that it can neither turn, contemplate, nor examine itself, neither free itself from its confinement: And this seems not to have been done in vain by the wise Creator, but for many reasons, founded on the most prudent views; among which these are not the meanest; *viz.* that it might not be fond of the continuance of its earthly imprisonment; and that, as at present, it often boasts beyond measure of its knowledge of external things, upon turning its attention upon itself, and discovering its own dullness, stupidity and self-ignorance, it might check its proud knowledge, and with so much the greater readiness submit to the divine wisdom.

Design of this Dissertation.

My design in this dissertation is to prove the great darkness that has overspread the soul of man as to the knowledge of itself: so that tho' the most sagacious philosophers employ the greatest degree of diligence and application, solicitously examine and use indefatigable labour; yet they can by no means clearly perceive, nor distinctly know the time of its beginning to exist, when, and in what manner, and in what part it is united with the body, nor what the nature of its substance is.

What its Measure of Knowledge of itself?

This is a theme that requires no small degree of prudence, in order to avoid the rocks of Scepticism, which is deservedly detested: For, tho' I affirm,

affirm, that the soul is ignorant of many things relating to itself; yet that its knowledge about itself is not entirely uncertain or none at all: I only attempt to separate certainties from uncertainties and doubts, that vain speculations may be banish'd from philosophy; and that we may not in the manner of boasting Quacks talk of every thing, as if we understood them; but rather modestly confess our ignorance about things unknown, that those things that are truly known may appear to the greater advantage, and that upon these, as on a sure foundation, we may raise a structure that shall remain unshaken, and shall never be overthrown.

Let us first enquire into the original and natal day of the soul.

When a man of ripe years and experienc'd judgment contemplates himself and the power he exercises over his own soul, his ideas, and his body, he finds that power so weak, and confined to such narrow limits, that he can by no means discover in himself any power of giving existence either to himself, or to other things without him; but that a power is wanting far, nay infinitely, exceeding his own; that operates in another and quite different manner; not like our power, on things existing only, but likewise on things that do not exist, which by his bare word he calls forth to existence: We therefore hold, that the human soul is derived from the Divine Being alone, not as a particle taken from his essence, according to the *Pythagoreans* and *Stoics*; seeing an infinite and simple being cannot be divided into finite parts; nor as inherent in the divine essence, as the *Manicheans*, *Marcionites* and *Gnostics* hold; nor as a mode of God himself, as the subtle *Averroes* and *Spinoza*, that unhappy genius, do maintain: But that it is a finite being, endued with limited faculties, that it is entirely different from the divine Being, and created in a manner incomprehensible to mortals, does very evidently appear from the weakness of human power. Some of the ancients have, with *Democritus* and *Aristotle*, held that the soul was *ex traduce*, or propagated by the parents: And this opinion is maintain'd by *St. Augustine*, or at least is doubtfully propos'd by him; and to his sentiment *Hierardus*, *Pomponatius*, *Scaliger*, *Sperling* and *Rudiger*, may be said to give in. But neither their reasonings nor authority move me: For, who is he that is conscious to himself, that besides a small corporeal bulk, he has also deriv'd his soul from his parents? Or who can undoubtedly know it? Or how from the soul, a simple being, and not consisting of parts, could other souls be deriv'd as parts thereof? Or with what propriety shall we ascribe to it a power of creating, a thing we do not find in it.

But all our knowledge of the creation of the universe, and of all the things contain'd therein, we derive from *holy Writ*, and from it, we certainly learn, that all the things, which fill the spacious seas, the wide regions of the earth, and the boundless expanse of heaven, were in six days created out of nothing.

Were,

Enquiry into the
Original of the
Soul.

Different Op-
inions about it.

The Account of
the Creation only
from Scripture.

The Time of
the Soul's begin-
ning to exist.

Were, therefore, the souls of all the men, who were afterwards to become inhabitants of this earth, created by God in the beginning of the world, at least a great while before the bodies, to which they were in time to be united? Or are they successively produced, as parents happen to be succeeded by their progeny, and directly infused into human *fœtus's*, just ready to be born?

Various Disputes
about it.

On all these heads there is a profound silence among the *inspired Writers*: It is, therefore, not to be wonder'd at, that the luxuriant fancies of philosophers, so very fond of controversy and disputation in doubtful matters, have on this head run into various opinions.

Plato's Opinion

The subtle *Plato* had assigned places to the souls in the visible heavens about the stars: And as they had a hankering after sublunary things, had condemned them to bodies, as to so many prisons; in which being confined, they should forget all their former knowledge, which they were afterwards to recover by long and much exercise. But in what manner and by what reasonings had the philosopher made this discovery? And by what evidence of argument did he prove, that souls are depriv'd of the memory of their former knowledge, as soon as they are united to bodies? Nay, by none at all. He had only framed to himself these idle notions, which yet many philosophers afterwards, (on the Authority of *Plato*) and the ancient Fathers of the Church, tinctur'd with *Platonic* notions, had favour'd and propagated; nay the very same notions, if we may credit *M. Tournefort*, are at this day maintain'd by the *Armenians*.

Whether created
at the Time of
its Union with
the Body.

Others on the contrary have held, that the souls of men are created by God at the time of their union with their new bodies: And these seem to defend the much more probable opinion, and to have confirmed it by better arguments: Because otherwise the souls would remain depriv'd of all knowledge and thought from the beginning of the creation, till their union with the body, and continue in a long state of inactivity, and without answering any one useful purpose; and again, it is not a very easy matter to conceive, how they could live without thinking: Yet let no one imagine that these reasonings are genuine demonstrations, and by their evidence above all exception; for, we are hitherto ignorant what the life of the soul properly is; if we suppose it to consist in thought, we shall have said no other thing than that the thinking soul is thinking; and if God had a mind to create all the souls of men at the beginning of the world, and keep them for a stated time under certain laws, his will alone is sufficient, and his power sufficiently efficacious.

A Thing not ea-
sily determin'd.

If we now enter into the inmost Recesses of the soul, and enquire, whether it possesses the immediate knowledge of its own original; and whether it began to exist from a great number of years backwards, or but very lately, it is entirely at a loss, and finds in itself no signs of its first original; so that weighing thoroughly the reasons on each side, we must own, that
the

the natal day of our souls is absolutely unknown; and that philosophers have in vain attempted to explore or determine it. Now supposing that the soul is created, let us moreover enquire into the time of its union with the body, without giving in to any conjectures. The most sagacious enquirers into nature in our days have evinced, that the *semen masculinum* consists of living *animalcula*, with round heads, and slender and oblong tails, which are the first rudiments of the future man: One of these *animalcula* is convey'd into the membranous *ovum* of the mother, full of a nutritious juice. The *animalculum* being now receiv'd into the *ovum*, is subject to various transformations in the manner of caterpillars and many other insects: The bowels increase, the heart, which was a canal but a little before, is formed into a cone; the *thorax* and *abdomen* are closed up, and the limbs unfold; till in the space of nine months all the members have arriv'd to their degree of perfection; and then breaking thro' its prison, a tender infant is born into the world, who by his cries and tears shows the great pain it suffer'd in the birth, and that therefore, it either then is or has already been informed with a soul.

The modern Notion of Generation.

Who shall now pretend to discover the true time of the union of the soul with the body? Or after discovery, prove it? Has a soul been join'd to every spermatic tadpole, or only to that particular one, which enters the *ovum*? Or is the *fœtus* endu'd with it, after its first transformation? Or after the heart is entirely compleated? Or after closing up the *thorax* and *abdomen*? Or will you rather pitch upon the time in which the *fœtus* evidently moves, and manifest signs of life begin to be perceiv'd by the pregnant mother? Or rather in fine, when the new-born infant freely enjoys the open air, and now begins to respire? Each of these opinions may be maintain'd by men of the greatest sagacity of genius; may be very warmly disputed; and many and long chains of reasoning be formed thereon: Yet they will convince no one, who carefully attends to every circumstance, and who wants demonstration and not conjecture: For, here again we are involv'd in palpable darkness, out of which we cannot extricate ourselves. But possibly we shall attain to a greater degree of insight, after we shall have enquir'd into the ways, thro' which the soul has enter'd into the body, till it is firmly united to those parts, to which it afterwards inseparably adheres, while man acts his part on this stage of life: Now whether it enters with the first inspired air into the canals and vesicles of the lungs? and is immediately afterwards convey'd to the heart, and from thence along with the blood to the brain? Or rather by the nerves, that it may be united to their extremities, which it is afterwards to use as the instruments of all its future knowledge? Or whether it enters by other more patent, or more narrow passages? Or whether rather it is created in the brain itself, and comes to it from no other part from without? The

The true Time of the Union of Soul and Body impossible to be discover'd and prov'd.

soul is so ignorant of all these things, that in what manner soever it examines itself, it is entirely at a loss.

The Head the
Seat of the Soul.

The adorable Creator has assign'd the soul its seat and abode in the head; it is not diffus'd throughout the whole body, by possessing the arteries, veins, and the whole system of nerves, as some famous physicians in *Germany* would have it: For, they seem not to be appriz'd, that the soul can neither be extended, nor be of any bulk; for indeed, in that case surgeons and soldiers would exercise no small degree of tyranny over it, who by cutting away limbs of the human body, would likewise take away and lessen part of the soul: But that persons, thus maim'd, are not impair'd in their sagacity, wit and prudence, daily experience teaches.

Whether it lodges
between the
Dura and *Pia*
Mater.

But if the soul lodge in the head, shall we assign it its place between the two membranes, that envelope the brain? This place, it is true, may be sufficiently spacious; but these membranes afford only coats to the nerves: Besides, they are sometimes wounded, pieces of them cut away, and they are separated from each other, without dislodging the soul.

Or in the *Glandula Pinealis*.

But if we would rather chuse the brain itself for the habitation of the soul, shall we with *Des Cartes*, (who by the acuteness of his genius has gain'd himself immortal honour) determine for the *glandula pinealis*, so much celebrated? But both the putrefaction of this prominent body, and its petrification, the life and reason of the person remaining entire, have discover'd the error.

Or in the Extre-
mities of the
Nerves or *Sensorium Commune*.

Or shall we rather recur to the extremities of the nerves, which are subservient to the organs of sense? or to some shrine, as it were, which is call'd the *sensorium commune*, in whose *parietes* the nerves on all sides terminate? This opinion is, it is true, by far the more probable; since it is by means of the nerves that the soul perceives all objects, and operates on that body to which it is intimately present: But this opinion has not hitherto been confirm'd by solid reasons; for, who has made it appear, that the nerves do terminate, and are not rather recurring canals? Besides, for I incline not to be obstinate; suppose I grant that the nerves have two extremities; I shall then desire, that the most skillful anatomists shew the origin or termination of the nerves: It is not sufficient here to opine, that where the cortical substance of the brain ends, that from thence the medullary substance arises with produced or continued fibres, which are to terminate in the nerves; for, true and solid knowledge requires demonstration and not probability: Yet in this matter we will entirely depend on the diligence of skillful physicians, who may possibly by some contrivance or other harden the nerves, however soft and tender of themselves, and trace them from their origin to their termination; so as then to discover, whether they terminate in an extended cavity, the abode of the soul, or whether in any other manner not hitherto known; unless this place, in
which

which the unextended soul lodges, do, on account of its exceeding smallness, escape all our senses, tho' armed with glasses and other helps: We may, however, be allow'd to suppose, that a true extended place is assign'd the soul, from which the nerves, which themselves are really extended bodies, do arise; wherefore, the different nerves, subservient to the senses of tasting, smelling, feeling and hearing, have different originations. The man, who, applying himself to the investigating the structure of the brain, shall have found the shrine of the soul, shall deserve no less glory, nor shall his fame be less permanent than his, who shall have found the *perpetuum mobile*, the true quadrature of the circle, or the longitude at sea.

But it is no great matter of wonder to me, that the soul is ignorant of those parts it possesses in the brain, or rather to which it adheres: For, after it is condemn'd to its imprisonment in the body, it is tied down to it by the strictest bonds, so that it is not allow'd to expatiate beyond it, nor view the adjoining parts. It is like a captive, who is carried blind-fold from a far country into an unknown prison, that is shut up on all sides, except five little apertures, thro' which a very small portion of light from external objects does enter: Tho' now in its state of imprisonment it may be endued with the greatest degree of sagacity, and its eyes be unvail'd; yet by means of the light that enters, it discovers so few things, that it cannot divine in what region or part of the world it is: For, in order to know this, it must have had the liberty of going out, and viewing both the external and internal parts of its place of confinement: And being denied this, it must necessarily remain in perpetual ignorance.

The reason why the soul is ignorant of that particular part of the body it possesses.

But the soul observes, that it is a captive and united to its prison; because after all its efforts it cannot get out, without the destruction of its place of confinement; and this being greatly hurt, or the nerves affected, the soul suffers pain, which maugre itself it can by no means avoid: In other respects it knows not by any immediate sensation that it is tied down to its prison, nor does it learn by experience, or by attending to itself, how it is united with it. Hence it might be doubted, whether it was indeed united with the body, did it not conclude, by a careful train of reasoning, from many and undoubted observations, that it was really united in the closest, but in so artful and agreeable a manner, as to have no uneasiness nor any sensation of it. This exquisite and agreeable union of the soul with the body, and of which we have no sensation, was the reason that it was denied; and hence arose that call'd the *system of occasional causes*, and that other call'd the *harmonia præstabilita*: The former cultivated by F. Malebranche; and the other invented by M. Leibnitz, men of the profoundest erudition, and famous for their inventions of the most agreeable hypotheses and conjectures.

The soul insensible of its union.

The small apertures of its prison terminate in very long tubes, call'd the nerves; and by them is convey'd, as it were, to the soul all our

The knowledge
of external ob-
jects convey'd by
the nerves.

knowledge about bodies; and of this knowledge it remains depriv'd, upon compressing, hurting, cutting asunder and obstructing, either these tubes or apertures. He, therefore, who either wants eye-sight, or whose optic nerve is affected, is forever ignorant of light and colours: A deaf person never learns what sound, music and speech are: And he whose olfactory nerves are compress'd, knows nothing of odours, neither the fragrancy of sweet flowers, nor the stench of putrefied animals: And he whose nerves, appointed for the sense of tasting, are wanting, never discovers what is sweet, bitter, tart, salt, aromatic, nor any other degree of that sense: In the same manner as he whose nerves of feeling become paralytic, neither perceives what is hot or cold, smooth or rough, heavy or light. In vain have philosophers attempted to teach those depriv'd of this or the other sense those properties of bodies, which by their means we learn, while we are sound and in health.

We have proper-
ly no idea of
thinking, &c.

Let us now examine what the soul is, and what it knows about itself, or its own faculties. As soon as the soul perceives the images or ideas of things, that is, when it thinks, we experience that we understand and think. This faculty of thinking we apprehend by intimate sensation, internal experience or consciousness; and not by means of any idea, either reflex, or of any other denomination whatever.

As appears by
experience.

For, the use of ideas is, that the soul may know the objects placed without it, and which cannot enter into it; for, seeing its faculties are its proper endowments, internally inherent, and present to it, we have no occasion for the ideas of them, in order to know them. I appeal to every unprejudiced person, who weighing things impartially, does accurately examine himself: Let such a one try, whether he can find or form to himself an idea or conception of his faculty of thinking, judging, reasoning, or willing: Yet he must use this precaution not to confound the faculties of the soul with the present ideas, on which it operates. In my opinion such have erred, who have affirm'd, that we understand nothing but by means of ideas; and that the soul has only one way of understanding, and not a two-fold way.

Let us now, moreover, descend into ourselves, and carefully examine what each faculty is, how it is constituted, and how it is inherent in the soul; but we shall find that our utmost efforts in this case avail nothing; for, we here discover nothing clearly, only that we operate on ideas, and that in various manners when we do so. Faculties are necessarily inherent in some substance or thing, or as it is call'd, subject, which properly constitutes the soul, and is its inmost substance, its nature, and the *substratum*, as it were, of all its faculties. Who at first blush would not think that it would be a thing intimately known to the soul, as soon as it had examin'd itself; especially as it can embrace any occasion or opportunity of unvailings and descending into itself? But here we find the thickest darkness and the
greatest

greatest degree of ignorance! For, the soul discovers nothing about its own substance, but is all blindness in this respect; and tho' it makes the greatest efforts to penetrate thro' those thick clouds, yet all its struggles are in vain, and this substance passes all its penetration: In whatever manner it attempts to enter into itself it can find no admittance, every thing is close shut up, and all its efforts prove abortive: We are, therefore, oblig'd to own, that the substance of the soul is unknown, and that no idea, conception or notion can be form'd of it. This is no new doctrine, nor what has not been broach'd by others; but what the most diligent among the ancients were also appriz'd of, and is excellently well describ'd by *Cicero*, the prince of orators: "The power of the soul, *says he*, is not so great as " to see itself; but as the eye, so in like manner the soul, not seeing itself, " discerns other things; and it does not see, which is still less considerable, " its own form."

We need not therefore greatly wonder, that some philosophers, as *Dicæarchus* and *Aristoxenus* among the ancients, upon discovering this their ignorance of themselves, thought, that man had no soul at all: But if they had observ'd, that all bodies are endued with a *vis inertiae*, by which they can never of themselves produce any motion or action; and that man has a principle, by means of which he can produce or stop motion at pleasure, tho' unassisted, and without the accession of any thing else (supposing liberty) but the will: Then they would have discover'd, that man is not a mere machine, but a thing consisting of soul and body. Upon seriously weighing all these things thoroughly, it manifestly appears, that philosophers have not hitherto been more successful in discovering the nature of the soul than they have been in discovering that of bodies; for, that this latter is a secret to human understanding and wit, the principal Naturalists of our days have evinced.

Wherein the difference of soul and body consists.

But tho' we are ignorant of the substance and nature of the soul; yet by dint of reasoning we discover many things either unknown to the ancient philosophers, or perversely understood by them: But because we are always conversant among bodies, and are for the most part accustomed to think of them only, some people, incapable of forming clear and distinct ideas of incorporeal things, have held, that the soul is corporeal; that it is a breath of wind, or a subtile *aura*: Yet many have held, that it is of an igneous nature, which, according to *Cicero*, remaining uncorrupted and similar to itself, and flying upwards would penetrate thro' that region of the heavens where the clouds, rains, and winds are collected; and after reaching above that, would arrive to a nature similar to itself, consisting of a subtile *aura* and the temperate heat of the sun; and that then it would cease to mount higher: For, having attain'd to a heat similar to itself, as if it were equally pois'd, it would no longer move to any side. There are many philosophers, who in this agree with *Cicero*: *Epicurus* and *Lucretius*

Different opinions about the nature of the soul.

thought

thought that the soul is material; and that thinking is nothing other but the agitation of very minute particles. But omitting heathen philosophers, in whom such a gross error is excusable, we may indeed wonder, that there were so many among the ancient Fathers of the Church who thought, that the soul is indeed spiritual, yet some very subtile and rare body: For, *Clemens*, *Origen*, and their followers affirm, that indeed the soul in itself is very simple, yet always encompass'd with a subtile body. *Tertullian*, *Arnobius*, and *Methodius* tell us, that the soul is nothing but a very subtile body; nay, the Learned *Cudworth* and his excellent Commentator *Mossheim* ascribe the same opinion to *Irenæus*; seeing, according to *Irenæus*, the soul separated from the mortal body, is of a human appearance, and of the same form with its own individual body.

Locke's notion of the soul.

And has not even the acute Mr. *Locke* almost fallen into the same error? when he thinks, that the soul may be corporeal, and that God by his infinite power could have endued any portion of matter, arranged at his pleasure, with the faculty of understanding and thinking; an opinion, tho' not easily to be admitted, yet the celebrated *Buddens* has not scrupled to affirm, that it contains no absurdity. But had these men, who in other respects have deserv'd greatly of philosophy, consider'd, that in this manner they deprive matter of its *vis inertiae*, and endue it with a principle of acting at pleasure, they would have presently seen, that at this rate body would no longer be body, but be transform'd into something other quite different, whereby it could no longer be properly call'd body.

Cartes's attempt to prove the nature of the soul, and confirm'd by other arguments.

But the subtile and immortal *Des Cartes* is much more successful in this matter; and was almost the very first, who attempted to demonstrate that the soul is incorporeal, entirely different from matter, and purely spiritual. But tho' his arguments are by some reckon'd not conclusive; yet this excellent person deserves commendation, as he first led the way. But we may now prove this truth in a different manner; because whatever is corporeal has a *vis inertiae*, whereby it remains in the same state, in which it is, unless a change be made in it by other external causes: But the human soul operates alone, at its own will and pleasure, puts on various states and modes; at one time is employ'd in thinking only, at another time in judging, now forming different chains of reasoning, and again preferring and willing one thing rather than other, and sometimes exercising its power on the body; so that it must necessarily be a being of a different nature from the body: Besides, the soul seems to be a simple unextended being: For, were it extended, it would be divisible into various parts, or it would consist of parts, thro' all which thought would be diffus'd: But we perceive no such thing in the soul, whatever degree of attention we use. The soul, therefore, is not corporeal, but a spirit; a denomination that is familiar, but as to the thing itself we are all in the dark; seeing we can scarce form any notion, or conception of it: Wherefore, some of the more modern philo-

philosophers have asserted, and that not without reason, that when we are about to think of our soul, we borrow some first conception or other from bodies, to exhibit to us obscurely some thing or being, to which we afterwards ascribe all those faculties, we previously by a solicitous examination discover'd in the soul. Hence the acute and learned *Holmann* lays it down from experience; that when we would think of an immaterial substance, and abstract from it what we conceive to be proper and peculiar to material things, that we immediately quite lose any idea of it, and that there remain no longer any object of our thoughts: But let such, as seem to experience the contrary, beware, lest instead of the thing itself, they think only of the name, which unknowingly they may confound with it. It would, therefore, seem that we cannot think of any immaterial substances without a material idea: Sure, an instance of the great and deplorable weakness of the human soul, and of the great degree of its short-sightedness! since in order to form any tolerable conception of itself, it must conceive of things, obscure, confused, foreign, and dissonant with truth, on which as foundations, to build our small pittance of knowledge: But if the case was otherwise, and were men furnish'd with the clearest light and knowledge in this matter, they would not raise such warm disputes about the soul and its spiritual nature; but after mature and attentive examination would amicably conspire, and discover and demonstrate the very same truths. How great and how many have been the disputes, not only among the ancient *Greeks*, but also among the greatest Moderns about the different parts of the soul; one of which they suppose to be endued with reason, and the other not: By the latter some understand the animal spirits; others, some certain principle deriv'd from the *æther*; others, from a sidereal substance; and others again from some other matter; which principle they suppose to be the cause not only of the vital, but of all other motions subject to the will, and of the passions too; and that this part of the soul dies on the death of the person; but that the other part is by no means corporeal, but far more noble, a spiritual, intelligent, and immortal being; and they endeavour to strengthen their opinion by testimonies from *sacred Writ*: Whereas others, upon examining this opinion, demonstrate by better reasons, and likewise establish by scripture, that the soul in man is one simple thing, and not consisting of parts.

From such hints as these, it is, therefore, evident that the soul does not so clearly know itself, as some very subtle philosophers have thought; and the thing may be further easily made appear: For, I ask any one conversant in letters, whether upon turning over the writings of the ancient *Greeks* and *Romans*, he must not own, that there flourish'd among them philosophers of the greatest penetration and sagacity, who took a deal of pains to examine and know themselves: And yet how few things have they discover'd about themselves and their own faculties? And probably

we might have been for many ages longer in the dark as to these faculties, had not Mr. *Locke*, that great ornament of *Britain*, very sedulously applied himself to the investigating and clearly describing them; and other very excellent men, incited by his example, have discover'd new ones: Nor shall posterity be depriv'd the glory of discovering more, if treading in our steps, they pursue the true method of philosophizing, banishing *hypotheses* and laying aside a pruriency of framing conjectures, they only admit of what is certain and true, and not confound with it things doubtful and uncertain, but lay these quite aside: Besides, they may not only give a scope to their own meditations, but likewise make observations on other people, remarking how infants, young people, people of maturity and old people, both in a state of health and under different distempers, exercise their thinking faculty. Solid reasonings, deduced from such observations as these, will become true and unshaken demonstrations.

A short Sketch of Reflexions on the Originals of Nations, chiefly taken from their Languages; by G. G. L. From the Miscellanea Berolinensia. Tom. I. p. 1.

Translated from the LATIN.

The original and antiquity of Nations deriv'd from their language.

AS the remote originals of nations rise higher than our accounts of them from story, their languages serve us instead of ancient documents: And the most ancient traces of languages remain in the names of rivers and woods, which, after changing their inhabitants, do for the most part still continue: Next to these are the appellations of places built by men: But tho' many villa's and towns are named from their founders, a thing very frequent in *Germany*, which was more lately inhabited; yet other places are denominated from their situation, their produce and other qualities; and the etymon of the more ancient names is difficult. The ancient appellations of men, of which no nation in *Germany* have retain'd more than the *Friezlanders*, do even lead us into the inmost recesses, as it were, of the ancient language: For, I lay it down as an axiom, *that all those names, we now call proper, were some time or other appellative*; otherwise there would be no manner of accounting for them: So often, therefore, as we understand not the name of a river, mountain, wood, nation, village, town, &c. we ought to take it for granted, that we have so far receded from the ancient language. Thus so often as the name of a *German*, as for instance a *Frank*, *Allemann*, *Saxon*, *Goth*, *Vandal* terminates in *ric*, as in *Theoderic*, *Frederic*, we should possibly be at a loss that it denoted valour and strength, did not *Venantius Fortunatus* thus explain the word *Chilperic*: But for the most part, in tract of time, the ancient and native

native significations are either chang'd or obscur'd; for, languages did not proceed from any institution, nor were they establish'd by law, but arose from a certain natural instinct, whereby men modell'd the sounds to the affections and passions of their mind: I except artificial languages, such as was that of Bishop *Wilkins* (which notwithstanding scarce any one learned besides himself and Mr. *Boyle*, as the latter told me) and such as *Golius*, no despicable judge, suspected the *Chinese* language to be; and such also, if there was any such, which God taught mortals: But in languages that arose by degrees, words were fram'd occasionally from the analogy of the word with the affection, which accompanied the sensation of the thing; and in this manner, I may suppose *Adam* gave names to things.

But tho' we may hence easily conceive, that many peculiar words were framed in process of time by various nations, especially at a time when rude barbarism, influenc'd by instinct rather than reason, broke out at random, as occasion offer'd, from the passion into articulate sounds, which varied according to the temper of the mind and the frame of the organs of speech, the use of which is not equally easy to all nations; yet it is worthy of remark, that the traces of a certain ancient language, which was very widely spread throughout great part of our continent, does still remain in our modern languages; since there are many words, which in their use extend from the *British* ocean as far as *Japan*. I forbear to adduce the common instance of the word *saccus*, as being what I have not sufficiently examin'd; But I shall mention another word, us'd by the ancient *Celtæ*, among whom *ma* denoted a horse; whence *Pausanias* informs us, that a triple order of horse was by them call'd *trimarchia*: The word *mare* or *māre* was well known to the ancient *Teutons* (among whom *Marescallus* denoted a person who was over the horse) and it still remains among the *Germans*. The same word *mar*, or its cognate, is likewise understood in the same sense by the remotest *Tartars*, who conquer'd *China*: Such likewise is the word *Kan*, which signifies a potentate, a principal personage, a king; but *Chagan Can* denotes to the *Sarmatians*, *Huns*, *Persians*, *Turks*, *Tartars*, and *Chinese*, a prince; and indeed in pronouncing the initial letter *K*, we perceive no uncommon force employ'd; and the breath breaks out with violence: So often, therefore, as the same word, or a little transform'd, is found in common to *Britons*, *Germans*, *Latins*, *Greeks*, *Sarmatians*, *Fins*, *Tartars*, and *Arabs*, (a thing not so very unusual) it affords a trace of the ancient common language: So that we must either say, that the better part of *Europe* and *Asia* was some time or other under one great empire, where a certain common language prevail'd, (as the *Latin* more lately overspread *Europe*; the *Greek* and *Arabic*, *Asia* and *Africa*) or rather (which is more consonant with *sacred Writ*) that all other nations were colonies of one nation, or deriv'd from one common stock, tho' among the more remote colonies the traces of affinity may be gradually wore out: For, new

The traces of an universal language in the modern languages, and how it came to be corrupted.

languages do easily arise from the admixture and corruption of the other languages; and I remember to have heard an *English* lady, who spoke *French-English* and *English-French*; and some hundred such persons would have easily coin'd a new language for posterity; as the language of the *Grisons* at this day is a corruption of *Italian* or *French*, as these are of the *Latin*; and the repeated corruptions of corruptions do at length confound all the lineaments of the original language: I, therefore, wonder not that no affinity can be found between the languages of the inner parts of *Africa*, and the *American* languages and ours.

Two great branches of the ancient language.

We may with propriety enough divide the languages, deriv'd from that ancient diffusive language, into two kinds, *viz.* the *Japetic*, if I may use the expression, and the *Aramæan*; the former fill'd the north, in which I comprehend all *Europe*; the latter, the south: And if you allot the northern parts to *Japhet*; the southern parts will properly fall to the posterity of *Shem* and *Ham*: The Mythologists themselves have placed *Japhet* and his son *Prometheus*, who was the framer of men, near mount *Caucasus*; the *Aramæans* (or the *Arimi*) were known to *Homer* by the name of *Syrians*.

Extent of the Arabic language.

Among the southern languages, the *Arabic* especially is very diffusive; for, it fills the great *Peninsula* between the *Red* sea and the *Persian* Gulph; and the neighbouring languages, as the *Syriac*, *Chaldaic*, and the *Hebrew* itself have a very great affinity with it: The *Hebrew* has been made a kind of dialect of a greater language; and it sufficiently appears that it is preserv'd but in few monuments; nor is this to be wonder'd at, as it possess'd but a small part of *Syria*: But it may preserve its ancient traces better than other languages, as no other nation afford us more ancient records: It is plain that *Carthage* was built by the *Phenicians*; and *Reinesius*, *Bockart*, and others, have excellently well illustrated the *Punic* language (a scene in which language is extant in *Plautus*) from the *Hebrew* and the cognate languages.

It moreover appears from the consideration of the *Abyssinian* language, that colonies of *Arabs*, after crossing the *Red* sea, had possess'd themselves of the better part of the eastern *Ethiopia*; nor is the *Ambaric* language different from the common *Ethiopic*, but in dialect. It is said that a great deal of *Arabism* is found among the inhabitants of the *Indian* coast, where the *Malabaric* language extends as far as the islands; on which head *Reland* has things worthy of remark. The *Egyptian* language, which at this day is call'd the *Coptic*, differs much from the *Arabic* and the cognate languages; and it is possible that it proceeded from the most ancient *Ethiopians*, before the *Arabs* pass'd over into *Ethiopia*. The *Persian*, *Armenian*, and *Georgian* languages seem to arise by a mixture of *Scythians* and *Aramæans*, as bordering on them; but from the most ancient *Scythians*, whom their own posterity at this day would not understand. The ancients have handed down to us, that the *Parthians* (who are also *Persians*) came as
exiles

exiles from *Scythia*. I could not find so much of the *German* language in the *Persian*, as *Elichmannus* told *Salmasius*; and excepting almost the word *God* alone, the rest, for the most part agreeing with the *German*, are in common to them with the *Greeks* and *Latins*. *Acoluthus*, a man well skill'd in the oriental languages, was of opinion that the *Armenian* language had a common foundation with the *Egyptian*; and he explain'd to me at *Berlin* the reasons of his opinion, but they were little satisfactory. The ancients, indeed, have recorded, that a colony of *Egyptians* was left by *Sesostres* at *Colchus*; how truly I shall not say. But our greatest attention should be applied to those languages that are separated and cut off from all communication with the others; for, there the originals lie deeper.

Whatever is common to the northern languages you may call that *Japetic*, and I usually call it *Celto-scythic*: I here, therefore, refer what is common to the *Germans* and *Greeks*, but of an older date; for, what came more lately from the *Greeks* to the *Germans* by the commerce and learning, of the *Gauls* and *Romans*, and by their studies and sacred rites, does not belong to this place: I likewise refer hither what the *Germans* have in common with the *Sarmatians*, *Finns*, and *Tartars*; for, if it be true, that the inhabitants of *Europe* came from the east, following, as it were, the course of the sun, it appears that swarms of men, coming from *Scythia*, and passing the *Tanais* and *Ister*, penetrated partly into the west, that is into *Illyrium*, *Pannonia*, and *Germany*; from whence, at length, their posterity advanc'd towards *Italy*, *Gaul*, and *Spain*; and partly they directed their course to the south, into *Thrace*, *Macedonia* and *Greece*, where more lately colonies arriv'd from *Phenicia* and *Egypt*; whence the letters of the *Greeks* are owing to the *Phenicians*, and their religious rites to the *Egyptians*: But the *Scythians* laid the foundation, as it were, of the *Greeks*, as the *Celtæ* did that of the *Italians*.

What is common to the northern languages call'd *Japetic* and *Celto-scythic*.

By *Scythians* I here understand the most ancient inhabitants of the coast of the *Euxine* sea, of whatever denomination they are; there *Homer* plac'd the *Cimmerians*, and these *Herodotus* has distinguish'd from the *Scythians*. The *Tanais*, *Danaper*, *Danaster*; and the *Danube*, not to mention the *Duna* and *Dwina*, were names impos'd on these four great rivers by one and the same nation; and they are pronounc'd by *Jornandes Gothus*, in such a manner that their original becomes manifest, but is now in part suppress'd by the contracted pronounciation of posterity: For, *Dniester* and *Dnieper* scarcely retain their ancient radical letter in the beginning; much less do *Niester* and *Nieper*. What favours the *Scythian* original of the *Celtæ* is, that some words of the ancient *Scythians*, preserv'd to us by *Herodotus*, are excellently well explain'd from the *Celtic*, that is, the *Latin* or *German*; for, *Aeorpata*, an appellation of the *Amazons*, does, according to *Herodotus*, signify men-slayers; *Aeor* denoting a man, and *pata* to kill: Moreover, *battere*, *battuere* signify'd to the ancient *Romans* to beat; and it still re-

Some instances of the original of the *Celtic* from the *Scythian* languages.

mains in those languages, corrupted from the *Latin*; and there are some traces of it in the *German*: For, they use the term *patschen*, to denote striking with any broad thing, as with the sole of the foot, palm of the hand, water or any other yielding matter; and is a word deriv'd from the sound. It appears that *vir*, *baro*, *herus*, *berr*, *er* are cognate; with which agrees *aeor*, as *oir* with *vinum*.

Further instances.

No less happily is the word *arimaspi* explain'd; for, according to the testimony of *Herodotus*, it signified one-eyed. By *arima*, says he, the *Scythians* denote one; and *spu* signifies the eye; not as if this nation wanted one of their eyes, but because they chiefly used one in aiming: *Arim*, moreover, signifies unity, solitude, paucity; therefore, *eremus* to the *Greeks* denoted solitude, and *arm* to the *Germans*, poor. *Arim* which signified one among the *Scythians*, is now call'd by the *Georgians* *erti*: But *speben*, *specere*, *spia*, *épier*, denotes among the *Germans*, *Latins*, *Italians*, *French*, and in a word among the *Celtæ*, to see: And hence manifestly appears the word *arimaspus*. In its original signification *speben* denotes a sharp look; as if it would pierce through; for *sp* is generally used by the *Germans* in actions and instruments of penetrating. *Herodotus* relates that he convers'd with a *Scythian* prince; and perhaps he went to the borders of *Scythia*, as he was indeed a great traveller; and therefore he generally deserves the greater credit in his relations: Besides, it is not to be wonder'd at, that some things relating to the ancient *Scythians*, in a language and nation so remote, should escape our knowledge: But I would not waste conjectures on the name of *Xamolxis* the *Getan*, of *Anacharsis* the *Scythian*, &c. but I could wish that the *Scythian* words were collected by some learned person, as the *Gallic*, *Phrygian*, *Egyptian*, &c. have been collected from the writings of the ancients. Now *Hesychius* supplies us with some *Scythian* words.

What languages
compriz'd under
the *Scythian*.

Under the name of *Scythian*, distinguish'd from the *Celtæ*, I comprehend the *Turcico-Tartaric*, the *Sarmatic* and *Finnic* languages, tho' these three differ much from each other. The *Turks* were a people known to the ancients: The name of *Tartars* arose, when they broke out to the destruction of the world under the command of *Chingis-Cani*. It is sufficiently apparent from the language of both nations, that the *Turks* came from those countries, which are now inhabited by the *Usbecks*, that is, from the *Massagetæ*, or *Scythians* bordering on *Persia*, and that the language of the *Crim* has an affinity with the *Turkish*; and we are told that the *Calmucks* themselves (which I take to be a modern name, and given them by the *Russians*) say, that the *Mogalli* (which is an ancient appellation) come near the *Turks* in their language; nay, the more eastern *Tartars* themselves, who conquer'd *China*, have many words of an affinity with the *Turkish*, with some of which *F. Bouvet* supplied me. I have found by certain indications, that the *Comani* are of *Turkish* original; who,
at

at the time when the *Tartars* made their first incursions, inhabited between the *Tanais* and *Danube*; and there is still a remnant of them in *Hungary*, whither they had fled from the *Tartars*; but with the loss of their language, if I mistake not.

The *Sarmatians* are a nation, that was for a long time backwards, and now is, no less widely spread over *Asia* and *Europe*. *Herodotus* took the *Sauromatæ* in a stricter acceptation; but *Tacitus* opposes the *Sarmatians* to the nearest *Germans*: It therefore appears, that he meant those nations, which were afterwards call'd *Sclavonic*; under which we comprize the *Russians*, *Poles*, *Bohemians*, *Moravians*, *Bulgarians*, the modern *Dalmatians*, the *Slabini*, and other inhabitants of the *Adriatic* coast; as also the nations of the *Vinidi* near the *Baltic*, commonly call'd *Wendi* (not to be confounded with the *German Vandals*) and by *Jornandes*, *Antes*; and all those who, after the migrations of the *German* nations, succeeded into their deserted habitations, and possess'd all that tract of land between the *Mare Barbarum* (so the ancients call'd it) and the *Elbe*; nay, even as far as *Salfeld* in *Thuringen*. It is well known, that the *Vinidi* (some of which still remain in *Lunenburg*, and more of them in *Lusace* and the *Marckt*) lately supplied the place of interpreters to the *Muscovites*; and *Sparwenfeldius*, the *Swede*, a man skill'd in the oriental languages, affirm'd to me by letter, that the language he had learn'd in *Muscovy* was of service to him in his travels in *Carinthia* and *Carniola*. *Jornandes* places the *Winidæ*, a populous nation, almost in those countries, which at present comprize *Poland* beyond the *Weissel*; and he divides them into *Antes* and *Slabini*: But I suppose that the *Antes* and *Wendæ*, or *Winidæ*, differ only in pronunciation; the letter *W*, as commonly happens, being sometimes set before, and sometimes omitted.

The *Sarmatians* spread over *Asia* and *Europe*.

To the *Sarmatians*, or the *Slavi*, I also reckon the *Huns* and *Avars*, who possess'd what now goes under the name of *Hungary*, but formerly *Pannonia*; for, after that the *Goths*, *Lombards*, *Gepidæ*, and other *German* nations passing over into *Italy*, *Rætia*, and among the *Hedui*, &c. either spontaneously, or driven out by new comers, deserted all that country, that lies between the *Danube* and the *Alps*; the *Slabini* succeeded in their room, a part of whom coming later were call'd *Avars*: Whence likewise, at this day, all that tract is inhabited by *Sclavonic* nations; except where the *Hungarians* (a nation of another original) broke in; nay, even it appears from their language, that in *Hungary* itself the *Rascii*, *Servians*, *Croatians*, *Ziculi*, and most of the inhabitants of the *Upper Hungary*, are of *Sclavonic* original. Besides, among the ancients, the *Huns* and *Avars* in *Pannonia* were in *Charlemagn's* days join'd together, and at one time the *Huns* were comprehended under the *Avars*, and at another time the *Avars* under the *Huns*: But before that time *Jornandes* made mention of certain plains

The *Huns* and *Avars* likewise *Sclavonic*.

plains on the *Danaper*, call'd *Hunnivar*; and even *Simocatta*, and other *Greek* writers, have made mention of the nation *Hun* and *Var*.

Farther proof
thereof.

It likewise appears from other indications, that the nation of the *Huns* is *Sclavonic* or *Sarmatian*; tho' by some *Greek* writers the *Turks* are call'd a *Hunnic* nation; but then the word is taken in a large sense, so as to denote the same thing as *Scythian*: For, it so happen'd that those remoter *Barbarians* were by the ancients call'd by the general term *Scythæ*, by the writers of the middle age *Huns*, nay *Turks*, and by the more modern writers, *Tartars*: It appears by the embassy of *Priscus*, the rhetorician, that there were only two languages spoke in *Attila's* court, the *Gothic* and *Hunnic*; and it is manifest, and even the names of their kings sufficiently shew it, that the *Gothic* is *German*; but the *Hunnic*, were it not *Sarmatian*, should have been the third language us'd there, since *Attila* was then in the heart of the *Sclavonic* nations. It moreover appears, that the word *Coni*, or *Cbuni*, denotes a horse to the *Sarmatians*; so that by the name of *Huns* nothing other than horse was meant; and it is manifest, from the accounts of the ancients, that they always acted on horseback, just as their successors, the *Tartars*, do at this day. *Jornandes*, describing the funeral solemnities of *Attila*, makes mention of a great *Strawa*, that is, as he himself explains it, a feast; and *Eccardus*, professor at *Helmstad*, has told us, that a great entertainment is also at this day call'd *Strawa* by *Sarmatic* nations: I have likewise some indications, that the *Cazari*, formerly seated on the *Euxine* sea, were *Sclavonic*.

The great extent
of the *Finnic* na-
tion.

Another extensive northern nation are the *Finns*, whom *Tacitus* calls *Fenni*; and he describes their extraordinary wildness, such as is at this day that of the wild *Laplanders*, or *Samojedæ*: And indeed *Schefferus* has long ago told us from their language, that the *Laplanders* have a common original with the *Finns*; and those we now call *Laplanders*, are call'd by *Jornandes*, *Scridi-Finni* (from their speed; for, *Schreiten* signifies to stride, or make steps) but they extended farther into the east, as appears by the *Hungarians*, a people of affinity with the *Finns*; who, as appears from *Jornandes*, came from the *Inner Scythia*, or, as we now speak, from the hither tracts of *Siberia*; and *Rubruckius* sent by *St. Louis* to the *Tartars* learn'd, that *Old Hungary* was then call'd *Pascatir*, which I take to be the same with what, at this day, goes under the name of *Baskiria*, in the *Czar's* dominions; besides, no *European* language comes nearer the *Hungarian* than the *Finnic*, which, as far as I know, was first observ'd by *Comenius*. But *Fabricius*, who was lately sent from *Sweden* to *Persia*, on the account of commerce, accompanied with a young *Finn*, a relation of *Brennerus*, when in his journey, not far from the *Volga*, near the *Caspian* sea, he was paying money to the inhabitants for the hire of their beasts of carriage, he was surpris'd to find that their numeral names were almost the very same with the *Finnic*; and coming to talk with them, he both understood a
great

great many of their words, and was understood by them: I am, therefore, of opinion, that an ancient large and continu'd nation from the northern ocean, as far as the *Caspian* sea; was interrupted afterwards by the *Slavi*, or *Sarmatians*; and part of them wore out: And perhaps the *Estii*, *Libones*, and other inhabitants of the *Baltic* coast, who are of a different original from the *Slavi*, should be reckon'd to the *Finns*; tho' we who are ignorant of these languages hardly admit of this; and I suspect the same thing of the *Samojedæ*. The *Hungarians* came later from *Asiatic Scythia* into *Pannonia*, and fill'd the champaign country, at the time that the inhabitants, the *Avares*, weaken'd by *Charlemagn*, could not defend themselves; and from hence *Pannonia* (except that country which, at this day, from its eastern situation is call'd *Oestereich*, or *Austria*, and join'd by *Charlemagn* to *Germany*) took the name of *Hungary* from its new possessors; and the inhabitants remain'd a mixture of *Avares*, or *Slavi*, and *Hungarians*. The *Hungarians* were by the *Greek* writers of the lower age compriz'd under the name of *Turks*; the *Turks* had the appellation of *Persians*, and the *Greeks* themselves had that of *Romans*, to keep up some face of the ancient empire.

So far of the *Scythians*. I come now to the *Celtæ*, who possess'd almost all that part of *Europe*, extending from the *Scythians* to the *Mediterranean*, the ocean and the streights of *Gibraltar*. It appears, that formerly a part of the *German* nations inhabited as far as the *Tanais*, tho' they were interrupted by the *Winidæ*, or *Antes*; and not long ago there were some remains of *Germans* in the heart of the *Crim*, and possibly they still remain to this day. The *Germans* afterwards, weaken'd by their migrations, ceded to the *Slavi* all the country as far as the *Elbe*; yet, at length, they recover'd most of the country as far as the *Baltic* and the *Weissel*. The *Bastarnæ*, beyond the *Carpathian* mountains, were formerly reckon'd to the *Germans*; but I would chuse to reckon the *Daci* and *Getæ* to the *Sarmatians*. The ancient *Illyrians* and *Pæones* were formerly, in my opinion, *Celtæ*, that is, *Germans* or *Semi-Germans*. But the *Sclavonic* language is with no propriety call'd *Illyric*; tho' at this day the *Slavi* possess *Illyrium* and all the neighbouring parts: For, their migration was later. *Livy* denominates the *Alpine* nations, *Semi-Germanic*. I reckon to the *Germans* all those *Celtæ* which extended from the *Rhine* to the north and east: But the *Celtæ*, on the other side the *Rhine*, belong'd to the *Gauls*; tho' the original of the *Belgæ* was rather counted *German*, and upon a survey of the more remote antiquities, it is credible that the *Gauls* are for the most part descended from the *Germans*; and the *Germans* from the *Scythians*, as we have already mention'd: Tho' languages may be gradually chang'd by length of time, and by successive migrations.

The remains of the old *Gallic* language, collected by *Pontanus*, *Cambden*, and others, appear in no other language more than in the *Armoric* and *Welsh*: Remains of the old Gallic in the Armoric and Welsh.

Welsh: A vocabulary of this latter *Boxhornius* has inserted into his *Origines Gallicæ*. And from this it manifestly appear'd to me, that the *Welsh* has borrow'd a great deal from the *German*; and if, at this day, we little understand most words of that language, we must ascribe it to the frequent changes of times, places, and to the migrations of men. The islands receiv'd their inhabitants from the neighbouring continent. The ancient *Britons* are descended from the *Gauls* and *Germans*. The *Cymræi*, that is, the *Cambri*, or *Welsh*, I take to be from the *Cimbri*, as the *English* are from the *Saxons*; the successors of the *Britons* from those of the *Cimbri*; and because languages are less changeable in places inaccessible, I should think that the *Cymræi* came nearer to the ancient *Cimbri* in language than to the modern *Germans*. I may suppose the *Irish* to have sprung from *Britain* itself: The *Irish* language, therefore, represents to us the more ancient *Britons*, that is, the still more ancient *Germans* and *Gauls*: The most ancient *Celtæ* will, therefore, be again reviv'd in the *Irish*.

Italy and Spain
peopled by the
Celtæ:

It is credible that *Italy* and *Spain* receiv'd their inhabitants from the *Celtæ*, that is, from the *Germans* and *Gauls* passing the *Alps* and *Pyrenees*, long before that arrival of the latter *Gauls* mention'd by *Livy*; I mean the *Aborigines* of *Italy*, that is, its inhabitants, that are more ancient than the *Greeks*, *Lydians*, *Phrygians*, *Phenicians*, and others that came by sea: For, all the most ancient migrations were made by land; and it was later and uncommon for a great multitude to come by sea, tho' *Tacitus* be of another opinion. Many *Greek* colonies afterwards settled on the sea coast of *Italy*; and hence the *Latin* is a mixture of *Celtic* and *Greek*. Afterwards the hither part of *Italy* bore the name of the *Cisalpine Gaul*, and the further part that of *Magna Græcia*. In the middle the *Latins* and *Tuscans*, with their neighbours, possess'd a great deal on each side. We understand not the ancient *Tuscan* language, and the remains of it on some stones we cannot so much as read.

Remote antiquities of the *Spaniards* little known.

The remote antiquities of the *Spaniards* are also but little ascertain'd. *Reinesius*, in his treatise *de Deo Enderwellico*, has thrown some light upon them. Some fragments of the ancient *Spanish* literature remain on coins, which the Learned *Lastanosa* has collected in a treatise written in *Spanish*, and lately much enlarg'd and illustrated by *Baryus*. It is in vain to reckon these letters *Runic*; for, the *Runic* characters have no such signs of antiquity; and it appears that these coins were struck in the time of the *Roman* Republic, long before the coming of the *Goths*. The enquiry into the original of the ancient inhabitants is no less perplex'd. The *Celtiberi*, a great part of the *Spaniards*, came from the *Celtæ*, but later I suppose: For, it is credible that anciently the *Iberi* themselves were descended of the *Celtæ*; yet perhaps we must except the *Vascones*, and the people of affinity with them: For, the language of the *Vascones* differs surprisingly from all the *European* languages; nor is there any other found to which it has an affinity.

affinity. Shall we say that *Spain* was inhabited by a colony of *Africans* before the arrival of the *Celtæ*, and that the *Vascones* were remains of them? Or rather that some ancient nation of a former migration (before the arrival of the nation from which sprung the *Celtæ*, that is, the *Germans* and *Gauls*) possess'd not only *Spain*, but *Aquitain*, and all the neighbouring parts; and this is favour'd by the common names of rivers. *Cæsar* has distinguish'd three *Gauls*, viz. the *Aquitanic*, *Celtic*, and *Belgic*, where it appears, that the name *Celtæ* is taken in the strictest sense; and I should think, that it properly agreed to the inhabitants of *Celtic Gaul*; and afterwards taken in so large a sense by the *Greeks*, that came partly to *Marseilles* and partly to the *Ister*, that upon observing a certain similitude in their manners and language, it compriz'd all the west, which was unknown to the ancients: For, formerly the *Greeks* call'd the western people, whom they knew not, *Celtæ*; the northern, *Scythians*; the eastern, *Indians*; the southern, *Ethiopians*; denominating the remoter people from the nearer: And *Herodotus* has sufficiently shewn, (tho' he varies from himself) that the *Scythians* were a peculiar and no very extensive nation, which gave name to the nations of that tract; and was no less unknown to the *Greeks* in *Homer's* time than was that of the *Celtæ*.

As *Germany* supplied *Gaul* and *Italy* with its most ancient inhabitants; so it did *Scandinavia* somewhat later: For, I reckon it unquestionable, that the *German* nations pass'd over from the *Cimbrica Chersonesus* and the coasts of the *Baltic*, first to those islands now call'd *Danish*; and afterwards into *Scandia* itself; and driving out the *Finno-Lappones*, the ancient inhabitants, to remoter parts, possess'd the milder tracts along the coast: And indeed the *Danish*, *Swedish*, and *Norwegian* languages are plainly referable to the *German*, no less than at this day the *Italian*, *French*, and *Spanish* are to be reckon'd of *Latin* original; tho' these latter receiv'd the *Roman* language, not as descended of them, but as being under their empire, which is otherwise in the *Germanism* of the northern nations: Nor is it to be wonder'd at, that the northern and hither *Germans* do not understand each other, seeing a Boor of *Austria*, or *Bavaria*, does not understand one of *Westphalia*, or *Holland*. No *German*, at this day, could, without an interpreter, understand *Otfridus*, a *German* writer of *Charlemagn's* time; not to mention *Ulphila*, a much older writer. Thus by intervals of time, as well as places, first the dialects and then the languages undergo a change. But when words are set down in writing, so that one may have an opportunity of reflecting on them, the common original manifestly appears in most of them: The variation is greater in dialect than in language. Moreover, *Franciscus Junius* has especially deserv'd well of the ancient *German* language, and part of his lucubrations is preserv'd at *Oxford*. Dr. *Hickes*, excited by his example, has given us in a large and useful work a treasury of the northern languages, to wit the *Teutonic*; and lately in *Germany*

Scandinavia peopled by the *German*s.

Johannes Schilterus, and by my advice *Gerardus Meierus*, have attempted to illustrate the ancient *German* language.

The *Goths* descended from the *Germans*.

I am aware, that some learned men among the northern *Germans* have, at one time, fram'd to themselves a certain nation of *Goths*, different from the *Germans*; and at another time reckon'd *Germany* itself a colony of *Goths*. But no one can deny the *Goths* to be *Germans*, and oppose both the testimonies of the ancients and the evidence of matters of fact, unless he would incline to rival in obstinacy *Prætorius*, a *Gothic* author, who reckon'd the *Goths* to be *Sarmatians*: But it might be more easily credited, that the *Germans* came from *Scandinavia*, if the *German* nations possess'd its inmost parts towards the frozen ocean. But all the country, on both sides the *Sinus Boddicus*, is possess'd by the *Finno-Lappones*, a nation entirely different in language from the *Swedes* and *Norwegians*: I, therefore, take the *Finns* to be the true *Aborigines* of that large *Peninsula*, which, from its highest and a small part thereof, *Scania* (as it is call'd even at this day) or *Scandia*, or *Scandavia*, the ancients call'd *Scandinavia*: There are in those parts no traces of the *German* language, it being only found on the borders thereof: And, therefore, to derive the *Germans* from thence, would be the same absurdity as making all the *Arabs* and *Syrians* the posterity of the *Abyssinians*, or many ages hence making *London* in *England* a colony from *Boston* in *America*. It appears that *Suedilant* does at this day among the *Swedes* denote land newly broken up and turn'd into plough-land after burning the woods: For *sueden*, even among the ancient *Germans*, signify'd to burn. Whence remains, at this day, *sieden*, to boil, and *sud*, the south or warm quarter: But that country was broken up long before the *Roman* writers, since *Tacitus* himself makes mention of the flourishing nation of the *Suiones*, that is, the *Suedones*; and makes the *Suevi*, that is, a part of the *Germans*, to extend that far.

Whether the *Goths* came from *Scandinavia*?

Yet I own that colonies were sent from the northern to the hither *Germany*, but later: And indeed the *Cimbri*, *Saxons*, *Heruli*, *Vandali*, and other nations came from the *Baltic* coast; and *Procopius* tells us, that the ancestors of the princes of the *Heruli* dwelt in *Scandinavia*: And from thence *Jornandes* deriv'd the *Goths*. On the contrary, *Cluverius*, a principal author in ancient geography, places the *Goths* on the *Weissel*, and that from no contemptible arguments: But *Georgius Sternelmus*, a learned *Swede*, (who together with *Benedictus Skyttius* labour'd much on the harmony of languages) wrote a treatise with some acrimony against *Cluverius*; but his reasonings are not so solid. I do not entirely despise the authority of *Jornandes*, tho' I own it is not always to be depended on; especially in the remoter accounts; and I find him sometimes full of inconsistencies. He follow'd *Ablabius*, and the books of *Cassiodorus* on the *Gothic* affairs, which are now lost. *Jornandes*, therefore, derives the *Goths* from *Scandinavia*, tho' he confounds them with the *Getae*, the much more ancient inhabitants of

of the *Euxine* coast. I do not only reckon to the *Swedes* the eastern and western *Gothland* but *Jutland*, the *Gothones* on the *Weissel* (who were known formerly to the *Romans*) and the island *Gothland*: It was, therefore, possible that the appellation of *Gothones*, or *Guttones*, was some time or other common to the inhabitants of both sides the *Baltic*; and hence the sea itself was call'd *Sinus Codanus*, that is, *Gothicus*: And tho' the first, or more ancient *Germans* on the other side that sea, are undoubtedly descended from our *Germans*; yet it is not improbable, that afterwards a number of brave young men came again from *Scandinavia*, and settled the kingdom of the *Goths* in those parts on this side the sea; and that the original of the princes and leading men was by posterity and historians confounded with that of the nation itself; as if the whole nation had come from the same parts; or as if *Scandinavia*, which in my opinion was never very populous, were the nursery of these nations. This opinion is favour'd by *Jornandes* himself ^a, who lands the *Goths* among us with their king *Berig*, in three ships only: And indeed it is credible, that in the migrations of the *Goths*, as in those of the *Cimbri*, *Franks*, and *Saxons*, those who came from the remote parts were increas'd in number by the accession of others, who either spontaneously or by force came both into the expedition and name of that people. That the *Goths* gradually proceeded from the *Weissel* towards the *Euxine* sea, *Cluverius* agrees with *Jornandes*; but it appears that the *Bastarnæ* and other *Germans* were found there long before.

I take the migration of the *Asiatics* into *Sweden* (mention'd by the more modern mythologists of that nation) considering the great distance, and the difficulty of travelling even at this day, to be fabulous, and invented at the time, when upon the first reception of letters, the *Scandinavians* learn'd what *Asia* was. But it appears, that the *Asæ*, or *Heroës*, which arriv'd with *Odin*, or *Wodan*, came from the *Saxons*, who still inhabited *Cimbria*, and among whom *Wodan* himself reign'd, as far as may be learn'd from the ancient annals of the *Angles*, which are far more ancient than the histories of the northern nations: And therefore, the *Scandinavians* at one time receiv'd kings from them, and they at another time from the *Scandinavians*. The northern people corrupted *Wodan*, as being a foreign word, into *Odin*; for, they generally cut away the *W* from *German* words. *Jornandes* derives the *Danes* (or *Dæni*, as they are call'd by their neighbours,) from the *Cogeni*; and tho' he places them in *Scanzia*, you may therein comprize the outmost *Jutæ* as far as the promontory *Scagen*; and they afterwards coming from the river *Dena*, it appears they had the name of *Dæni*, and the country that of *Denemarck*; for, that river (at this day call'd *Eidora*, from *Heggidora*, as the ancients relate, or the gate of the fort) makes the limits or marches of *Jutland*. *Jornandes* relates that the *Heruli*, driven out by the *Danes*, did, together with the *Saxons*, practise

The original of the *Danes*.

pyracy on the *Romans*; and it is credible, that they were often conceal'd under their name.

Of the Original
of the *Franks*.

I need not much enlarge on the migrations of the *German* nations into the provinces of the *Roman* empire, since they are well known from history, and stand not in need of the support of languages; and yet there are some things on this head worthy of remark. It is manifest that those few *Suevi*, who have retained their ancient name, were mixt with the *Allemanni*. I should think that the *Boii* came into *Bavaria* from *Bohemia* and the *Marcomanni*, at the time the nations of the *Vinidæ* prevailed. We must treat somewhat more fully of the *Franks* and *Saxons*: Some Authors, and those of no modern date, derive the *Franks* from *Troy*, and again from the *Euxine* sea, and ascribe to them some certain town called *Sicambria*, as if they had some time or other inhabited *Pannonia*: But it is a prevailing custom among people, upon their first reception of letters, for their half-learn'd writers to devise strange stories; partly imitating the fictitious and idle relations of other people, and partly applying some of their own popular traditions to what they read in books: And hence arose among the *French*, *Britons*, *Scots* and *Scandinavians*, those prodigies of stories, which the northern people called by a *German* term, *Sagas*, that is, idle tales. Some learned *Frenchmen*, supposing that an ancient colony of *Gauls* was carried into *Germany*, do from thence derive the *Franks*; but how does it appear that the *Franks* came from that part of *Germany*, which the ancient *Gauls* are said to possess. I find that the original of the *Franks*, as well as that of the *Vandals*, *Goths* and *Saxons*, is to be deriv'd from the *Baltic* coast; not that they came from thence as a great nation, but that a number of brave men, sallying out, did in their progress grow into a mighty people: For, it appears, that upon occasion of the *Marcomannic* war, when under *Marcus Antoninus*, *Italy* itself was in danger, the *Barbarians* were encouraged by the hopes of plunder, and roused from their habitations; and from that time the fury of migrations continu'd, till the farther countries of the *Germans*, being exhausted, gave way to the *Vinidi*; and the hither countries, coalescing into larger kingdoms, were more quietly inhabited: Besides, the *Franks* did soon after settle among the *Hermunduri* and *Che-rusci*; from whence they proceeded to the *Rhine*, into the country of the *Sigambri* and the neighbouring parts; and gave name to that whole tract between the river *Maine* and the *Batavi*; and infested the *Gallic* coast, till at length they passed over into *Gaul*, when a later and still fiercer nation of *Saxons* succeeded them.

And *Saxons*.

Ptolomy was the first who mention'd the *Saxons* in the mouth of the *Cimbrica Chersonesus*, and not far from these *Tacitus* places the *Angles*, in which Author's time either the name of *Saxons* was not known, or it was confined to very narrow limits; but as they afterwards increased, and had joined with them the *Chauci* and *Frisii*, they became noted pirates, and made

made descents into *Gaul* and *Britain*, with a view to plunder; and hence both coasts are in the *Notitia Imperii*, called *Saxonicum*. It appears, that about that time the *Franks* were driven out of *Batavia* by them, and that before the *Saxons* settled in *Britain*: The same people succeeded the *Franks* in *Westphalia*; and afterwards the kingdoms of the *Werini* and *Thuringi*, (whose ancient names were *Cherusci* and *Hermunduri*) were partly overthrown by the *Franks*, and partly by the *Saxons*. The country of the *Werini* (if you except *Frisia*) ceded to the *Saxons*, and they also obtain'd part of *Thuringia* (which in *diploma's* was for a long time call'd *Norththuringia*) between the *Elbe* and the mountains of *Hartz*. Part of the *Saxons* also, together with their former neighbours, the *Lombards*, pass'd into *Italy*. At last under the *German* Emperors most of the country of the *Wenidi*, between the *Elbe* and the *Warta*, and even farther (partly the colonies of the *Germans*, and partly the natives assuming our manners and language) fell to the *Saxons*, and constitute the principal part of the upper Circle of *Saxony*.

Of the reputed Silesian Cotton. From the Breslaw Collection,
July 1717, Class IV. Art. VI. p. 76.

Translated from the HIGH-DUTCH.

ABOUT *Hirschberg*, *Kühnast*, and more especially about *Grieffenberg*, is found a new sort of cotton, of which we have not only had an account in writing, but likewise a large sample of it sent us: But we must in the first place observe, that it does not at all deserve the name of true cotton, 1. As it is entirely different either from the true *gossypium herbaceum*, or *arboreum*, as such is plentifully produced and found in *Asia*, *Africa*, *America*, and also in *Europe*, and particularly in *Syria*, *Egypt*, *Armenia*, *Persia*, *Bengal*, *Coromandel*, *China*, *Brazil*, and the *Antilles*, as also in *Spain*, *Calabria*, *Cyprus*, and particularly in the island of *Malta*; where especially the *gossypium herbaceum*, as the common cotton tree, does in its leaves and branches resemble the vine; yet it is much lower, and usually grows to the height of about two foot, and must every year be sown in the month of *June*, in fields properly prepar'd for it; and in such manner that the seed be previously sprinkled with ashes and water, to prevent its being eaten by the worms: Whereas on the contrary, the *gossypium arboreum*, or *gotne mségiar* is a true tree, and lasts for many years; but in *Egypt* it is rear'd only in gardens, and cannot be brought to such profit as the *herbaceum*, a figure of which we find in *Prosper Alpinus*^a, 2. As our cotton does not grow in any nuts or heads, like the true cotton,

Difference between the Silesian and true cotton.

^a De plant. Ægypti, fol. 29.

cotton, which is inclosed in a sort of nuts almost as big as walnuts, and found on the top of the stalk, which, when ripe, burst on four or six sides, and through the rent discover the inclosed cotton. In *Syria* and other parts it is cleansed by means of a round stick, which is fasten'd to a round iron bar, and then turned round; so that the shells or the seeds must remain behind: And this in the *Antilles* is perform'd by a small machine, which turns round by means of a wheel, and the cotton is in this manner clear'd from the shells and seeds, which last are as large as small beans, and hang on the cotton, in whose middle they grow; so that thus the cotton falls on one side, and the seed on the other. 3. Not to mention that the true cotton, as was said, contains in itself its seed, from which it is propagated. 4. The wool also itself is entirely different from ours, being as long as hair, and as strong as a thread.^a

The Description
and Use of the
Silefian Cotton.

Our cotton on the contrary is nothing other than the produce of a real shrub, whose heads grow on a long stalk, and bear the cotton; these heads are a small finger in length, round and beset with two sharp-pointed follicles, almost like an ear of corn, only that the upper spike of this *calix* stands almost bolt-upright, but the lower is bent outwards and downwards; and from their middle the flocks or downy threads, which yet are very short, stand out on a very small grain, smaller than the smallest poppy-seed, and beset the whole head so thick, that one can in no wise observe the *stamina* and *calices*; but in this their collected appearance they exhibit the bigness of a white mouse: Now this cotton is prodigiously soft and fine and feels like silk; white as snow, yet very short, and at the same time very tufty, and cannot be easily compress'd. In this form, it is true, it is on account of its shortness, not fit to spin, unless we could by art improve it, and draw it into long threads; but it appears to be very fit for lining of cloaths, as being much lighter and softer than cotton, yea even than silk itself; especially when it is open'd out, beaten and well clean'd, and as it may also be had in great plenty; seeing not only each head is stuff'd therewith, but even the trees themselves are full of it: So that as we are well assur'd, a whole basket may be fill'd with it from one tree only: Besides, this tree does not require the least culture, and is found pretty plentiful in other places besides the abovemention'd, particularly in marshy grounds, yet with this circumstance, that in five or six years growth at most, it turns rank, and yet it must not be grubb'd up: And to this we farther add, that this cotton is in no wise spoil'd by water, but after drying, retains its colour pretty well, only that it turns a little yellowish; but

^a Vid. *Dapper Africa*, p. 166. It. *Asia s. Persia*, p. 66. P. a S. T. *Oriental Reisebesch.* l. 7. c. 10. p. 427. Monconis *Voyage de Syrie*, p. 327. Walther Mulze *Reisebesch.* l. 3. p. 202. Prosp. Alpin. *de plant. Egypt.* c. 18. fol. 29. Rechi *hisor. nat. Brasil.* p. 308. Rochefort *Descript. des Antilles*, l. 2. c. 5. p. 102. Megiseri *Descript. Malt.* p. 249, 250, and many others.

but in substance it seems, indeed, to be improved; because then it is observable to be really firmer and closer, yet at the same time very soft, and perfectly fit for lining of cloaths; yet possibly by art it may be brought to a greater degree of perfection: It might also be worth enquiry, whether this cotton might not be employ'd for making of hats; and upon consulting some hatters on this head, we were told it was no impracticable thing: And for the future we shall embrace all opportunities of making more oeconomical and physical experiments upon this vegetable. But whether it was formerly taken for cotton, and whether the words of *Tannerus*^a have possibly any relation to it; 'cotton, that rarity of nature, 'is also found in *Bohemia*^b', is what we cannot assert for truth: At the least, as this wool very easily falls from its trees, so that when one goes under one of them, he is soon by the smallest breath of wind all over cover'd with it; and as on account of its lightness, it is usually carried by the wind far and near, it is very credible that the cotton-rain, that fell in *Poland*, Anno 1571, mention'd by *Paulinus*^c from *Spangenbergius*, might be owing to this or the like wool; as it is also well known, that the *gramen tomentosum*, which was once driven in plenty upon a meadow not far from *Hall*, is wont to produce plentifully a like wool, but of a greater length; not to mention the like sort of woolly stuff which is to be found on poplars and on other trees or shrubs: In fine, how far the *esula rara Indica*, which is productive of white silk, and which grows in *Moravia*, according to the testimony of *M. Hertodts*^d, is to be refer'd hither, we leave others to determine.

^a *Vestig. Bohem. piæ, notis ad c. 10.*

^b Vide *Bohusl. Balbinus Miscel. Bohem. dec. I. lib. 1. c. 49. p. 115. b.*

^c *Zeitküntzl. Lust. part III. p. 902.*

^d *Tartaromast. P. I. c. 17. p. 129.*

Of the Invention of the Microscope; together with some microscopical Observations. By Dr. Phil. Jac. Sachs à Lewenheimb. From the Miscellanea Naturæ Curiosorum, Ann. I. Dec. I. Obs. XIII. p. 40.

Translated from the LATIN.

AMONG the curious inventions of this age, the microscope is none of the least; as by it the smallest atoms and insects are magnified to a great degree: The *Italians* claim to themselves the honour of the invention, and mention *Franciscus Fontana*, a *Neapolitan*, for its inventor; and *Fontana* himself testifies that he first made the discovery at *Naples*, about the year 1618^a; and some years after, *Scheinerus* makes mention of him.^b *Borell* in the dedication to his microscopical observations,

Inventor of the Microscope.

^a *Traet. 8. de nov. cælest. & terrestr. rerum Obs. c. 1. p. 145. Rosa Ursinal. I. c. 30.*

tions, is of another opinion, who therein tells us that it was invented in *Holland*; and in another treatise ^a, he mentions *Zachary Jansen* of *Middleburg*, as the inventor (confirming it by many testimonies) who about the year 1590 had discover'd both the telescope and microscope; and in *cap.* 14. p. 34. he adduces the testimony of *William Borelius*, Ambassador of the *United Provinces* to *France*; to wit, that a certain citizen of *Middleburg*, named *Hans*, and commonly call'd the microscope-maker, had together with his son *Zachary* found out those glasses; and had presented the first of them to prince *Maurice* of *Nassau*, and another to archduke *Albert*, which this latter had made a present of to *Cornelius Drebbel* in the year 1619: As many learned men were afterwards appriz'd of the great usefulness of this instrument they seriously applied themselves to bring it to greater perfection; and in making of them *Franciscus Fontana* and *Torricelli* were famous in *Italy*: And at this day *Manfredus Settala* of *Milan* is no less famous for his optical instruments. *Eustachius de Divinis* has compleated a microscope in a new manner, 10 inches and $\frac{1}{4}$ in length; and it may be drawn out to four lengths; the first and least shows lines 40 times greater than they appear without a microscope; the second, 90 times; the third, 111; and the fourth, 143; and it has this peculiar to it, that it represents objects plain and not curve; and tho' a great part of the microscope be cover'd, yet it is surprising how much it magnifies^b.

In *France*.

Among the *French*, *Ferrerius Arvennas Choureus* and *Guil. Menardus* at *Paris*, and *Stephan. Breffyeus* at *Grenoble*, have been famous for microscopes, as also *M. Challomon* at *Aix*, and *M. de Servié*, at *Lyons*.

In *England*.

In *England* the best and most perfect were made by *Mr. Reeves* at *London*^c, and by *Dr. Hook*, who at great expence and after a great number of experiments, publish'd at *London* in 1665 his *Micrography* or description of minute bodies, together with the description of this instrument, which is the best in its kind.

In *Holland*.

In *Holland*, next to the first inventors of *Middleburg*, were *Hans*, the son of *Jansen*, a *Zealander*, and *Hans Lapperhey* of *Middleburg*, and *Cornelius Drebbel* of *Alcmaer*. *Isaac Vossius*'s microscope is mention'd by *M. Monconys*^d, consisting only of one hemispherule, which is put into a small piece of wood that draws out, behind a small black plate, excavated in form of an eye, and perforated in the middle with a small hole to look through. *M. De Hudd* at *Amsterdam* shew'd *M. Monconys* two different microscopes; one with one spherule only; another to which he applies a thicker spherule, at the part where the object is admitted, in such manner that the rays of light entering the spherule may illuminate the object. He likewise shew'd *M. Monconys* the method of preparing these spherules^e, for,

^a *De Invent. telesc.* c. 12. p. 26.

^b *Journal des Scavans*, tom. IV. p. 134. *Phil. Trans.* N. 42. p. 842.

^c *Moncon.* *Voyage* tom. II. p. 11.

^d *Ibid.* p. 153.

^e *Ibid.* p. 161.

for, he melted the metal for the spherule at the lamp, at which crystal glass is usually purified, by extracting the salt from it; while this mass is glowing hot it discharges the salt to the surface, which is afterwards easily remov'd; from the mass of glass thus depurated, he takes up a small portion on the end of his red hot iron rod, which he melts, and afterwards turning it round in the flame of the lamp, it becomes exactly globular.

Among the *Germans*, I reckon *Kircher*, who, in his treatise *de peste*^a, In *Germany*, says that his microscope is prepar'd with no less application than skill, that it magnifies a thousand times. At *Breslaw* for some years liv'd *Theodorus Moretus*, a *Jesuit* and professor of mathematics, who strenuously applied himself not only in divers mathematical instruments and different glasses, but likewise in microscopes. *M. Basilius Titelius* is no less famous for his microscopes, than for his military skill and knowledge in mathematics and physics. *Christopher Weickman* at *Ulm* is noted for his preparing of microscopes^b; as also *Wieselius* and *Daniel de Pierr*^c, his son in law, at *Augsburg*: And at *Vienna*, *Mattmillerus*.

Microscopes are prepar'd in different manners; some use two convex lens's; others large glass-spheres fill'd with water; others again the smallest spherule, whose diameter does not exceed that of the smallest pearl, and which they inclose in a tube, and look on its surface placed between the eye and the light; such as was that of the Cardinal *de Medicis*, which *Kircher* does not disapprove of^d; yet he prefers to all others an hyperbolical lens. More may be seen about the constructing of microscopes in *Fontana*^e. *Des Cartes* in his *Dioptrics*, *Hévelius* in his *Selenographia* publish'd at *Dantzick* in 1647, *Athanasius Kircher*^f, *Petrus Borellus* in his treatise of preparing microscopes, publish'd at the *Hague* in 1656, where he mentions from different Authors, constructions of it, and which he adds to his own method, *Jo. Christopher Kolbans*, in his optical treatise, and *Monconny's* in his travels^g.

Different methods of preparing microscopes.

To this account of microscopes we shall add some microscopical observations; and these relate either to works of art or nature.

Microscopical observations.

As to works of art; 1. The finest and smoothest paper appears rough in a microscope: For, in it are seen fibres, hairs, cavities, and innumerable inequalities. 2. The smoothest surface of glass appears very rough and full of cracks, fissures and inequalities. 3. The finest point of a needle, tho' it may seem to be imperceptible, appears by the microscope as broad as a quarter of an inch. The extremity of its point does not end in a cone, nor is it entirely round or flat, but blunt, unequal, irregular, resembling

On works of art.

^a f. 1. c. 7. §. 2. p. 70.

^b Ibid p. 320.

^c Ibid p. 328.

^d Ars Magna de Luc. & Umbr. l. x. p. 2. c. 8. § 5.

^e Tract. 8. de nov. cælest. & terr. Observ. c. 2.

^f 1. c. ^g Tom. 1. p. 117. — 128.

a broken nail ^a. 4. The edge of a very sharp razor appears in some measure like the back of a dog, with several teeth ^b. 5. The smallest points, used in printing for distinguishing the periods, appear like so many chefnuts ^c. 6. The threads of the finest webs appear like coarse cords, and the holes between the threads, which render the web transparent, nearly resemble the lettice of a window ^d. 7. The waves in tabbies do hence appear, because some parts thereof are more elevated, and others more depress'd, whence arise the different reflections of the light. ^e 8. The salt of *May dew*, prepared in a peculiar manner by Mr. *Henshaw*, and view'd with a microscope, did, in the number and figure of its angles, resemble nitre. ^f 9. The variety and true mixture of colours may be easily collected by the microscope; and of the colours discover'd by it Dr. *Hook* has treated in his micrography. ^g Some years ago M. *Christian Langius*, an excellent chemist, and professor of philosophy at *Leipzig*, at several times shew'd to his pupils, that a green colour by the microscope was nothing other than a mixture of white and blue. *Ludovicus Savotus* in his accurate treatise on colours, publish'd at *Paris* in 1613, shews, that a variety of colours arises from their different mixtures; from a yellow or a white, and a light red and a blue, a green is produc'd; from a small portion of a yellow and blue, arises a lively green; from a larger portion of blue and yellow, a dingy green and a dark green; if the blue prevail in the mixture, there is produc'd a sea-green; but if the yellow prevail, a yellow-green; and if some black be added, a *fueille-morte*: Thus when dyers and painters mix a red of grosser parts in small quantity to a yellow, they produce orange; but in a larger quantity, *zinzolin*; from a straw-colour and the least portion of a red of grosser parts is produc'd the *isabella*-colour. If to the *zinzolin* you add a little black, you have the *couleur de Roy*; but if more black, the *couleur de Minimes*; but a yellow is produc'd from a light red, and a pellucid white; a blue colour with white strikes a turcois blue, a sky blue, and a white blue ^h; a bright white mixt with a black makes a grey; and according to the proportion of both, and as the one or the other is predominant, a blue grey, silver grey, dingy grey, dark grey ⁱ; a red of gross parts mixt with a white, if the red prevail most, makes a dingy red; but if the white prevail most, a lively red, which in wool produces the scarlet; in silks, the crimson; and in fine, the carnation and the flesh-colour ^k: And it is credible, that the origins and mixtures of so many colours may be discover'd by the microscope; and from thence more new *phenomena* of colours be found out.

On the works of nature, and first in the mineral kingdom.

1. In the *astroites*, the seeming stars or roses are nothing other than fissures^l: Whence this stone is made to move by pouring vinegar upon it; and

^a *Jour. des Sçav.* Tom. II. p. 479. ^b *Ibid.* p. 480. ^c *l. c.* ^d *Ibid.* p. 461. ^e *Ibid.* p. 481. ^f *Phil. Transf.* No 3. p. 33. ^g *Jour. des Sçav.* Tom. II. p. 488. ^h *Savot.* c. 7. ⁱ *Id.* c. 6. ^k *Id.* c. 8. ^l *Berel. Obs. Microsc.* 6.

and if it was shap'd into the form of a tortoise, it would yield a surprising *automaton*, as *Kircher* observes^m; because the vinegar, insinuating with its spirit into the fissures, acts upon the salt of the stone, where in that mutual struggle and ebullition that more violent motion is excited, as I have also accounted for the local motion of crabs-eyes in my *Gammarologia Curiosa*ⁿ. Upon viewing each corpuscle of powder'd crystal apart, according to *Kircher*, it appears somewhat radiant °.

1. Rotten wood, view'd with the armed eye, exhibits a vast number of little worms; some of which have horns; some wings; and they have eyes like black points and a *proboscis*: So that the wisdom of the Creator is very much to be admir'd, as having furnish'd these *animalcula*, which are imperceptible to the quickest eye, with these members, without which they could neither move nor exercise any vital action^p. 2. In general, we observe in plants, herbs, and the leaves of trees, veins drawn with the greatest art, and in these a juice, with which are fed the veins of the roots; and we also observe, how that juice congeals and runs again: In flowers is seen a juice and a florid *ambrosia* running in their small veins^q. 3. In all herbs are seen very minute worms, which are produc'd according to the nature of the herb and plant, and which now degenerate into butterflies, and again into some other volatile insect^r. 4. In some leaves of plants are observ'd many little stars and collections of long atoms, and many spines stick out on them on all sides^s. 5. In capillary herbs, as the *lonchites*, polypody, *lingua cervina*, and other plants without seed, as is commonly thought, the seeds are discover'd by the microscope: For, they are tergiferous^t. 6. In most plants there are holes observ'd, as in the *hypericum*, dandelion, and spinage; yet these holes do not penetrate the plant, but are furnish'd with a small lucid membrane like a lettuce^u.

In the vegetable kingdom in general.

1. The entire external surface of a sage-leaf is rough, but by the microscope it appears as if cover'd with a cobweb, within which very minute *animalcula*'s appear, together with some little balls like eggs, spread over the surface: Which virulent brood, if rubb'd on the gums of a person without washing, proves noxious; but wiping the leaf with the finger, or washing it in water, they presently disappear^w. 2. Both the leaves and bark of the mulberry, if their texture be observ'd by the microscope, you will find that in their fibres they very nearly resemble yellow silk; *Borellus* has shown in the leaves of the mulberry a wonderful *plexus* or net-work^x. 3. The leaves of hoar-hound have tubercles and round rugosities resembling

In particular.

G 2

drops

^m *Ars Magnet.* l. 3. p. 3. c. 2. p. 562.

ⁿ l. 1. c. 14. p. 318.

^o *Mund. subter.* l. 8. f. 1. c. 8. f. 24.

^p *Kircher Scrutin. pest.* f. 1. c. 7. §. 2. Exper. 4. p. 74.

^q *Fontan. Obs.* 10.

^r *Kircher Scrutin. pest.* l. c. Exp. 3.

^s *Borel. Obs. Micr.* 6. ^t *Id. Micr.* 8. ^u *Id. Obs.* 5.

^w *Kircher de pest.* f. 1. c. 7. §. 2. & *Mund. subter.* L. XII. f. 2. c. 6. f. 369. ^x *Obs. Micr.* 63.

drops of oil^z. 4. The leaf of the *Sigillum Solomonis*, which to the naked eye discovers only 9 ribs, does by the microscope shew 74^a. 5. In the nettle we presently discover by the microscope whence it causes such a troublesome itching, and to what its power of raising pustules is owing: Over the whole herb, especially in its leaves, are observ'd prickles in the form of needles, nay with three points, with which the whole surface of the nettle is plentifully beset, whereby it evidently pricks; and from this painful compunction there afterwards arises a heat in the wounded skin, as many of the prickles are left behind in it; whereby the blood flows more copiously to those parts^b. *Hook* in his *Micrography* has also observ'd in the nettle, that its leaves are all over cover'd with very sharp prickles; whose base consists of a bag of a flexible substance, in form of a wild cucumber, with a sharp poisonous liquor, contain'd therein, which may be seen to rise and fall, if the extremity of the prickles be press'd with the finger against the base: Hence seeing the point, consisting of a very hard and strong substance, has a hole in the middle, from which that poisonous liquor may be discharged into the part that touches it, a sense of pain is thereby excited^c. In a *lixivium* of nettle-ashes *Kircher* affirms^d that it contracts a scurf of ice in the night, and that the whole nettle is represented on the ice itself: But by the microscope the entire appearance of the nettle seems to have been concreted from an infinite number of very small *stellulae*. 6. In a fresh small fig-leaf are seen on its back surprising rugosities, resembling obtuse cones: In the *Indian* fig a vast number of large prickles are observ'd; whence upon handling, it causes pain^e. 7. The leaves of sorrel exhibit oblong, rough and streight atoms in form of needles, by which it is probable that the tongue is twinged^f. 8. The leaves of the mastic-tree and the *liburnus* are full of worms^g. 9. In the leaves of the *palma Christi* is an innumerable collection of stars^h. 10. On borage are very rough prickles, and those jointedⁱ. 11. Common grass has striated leaves like the *Chinese* fillets, or rather like the leaves of striated grass, in which nature has more manifestly express'd it^k. 12. The leaves of the celandine are perforated^l. 13. The holes of *St. John's wort* are so magnified in the microscope, as to cause the greatest admiration^m. 14. The veins in the leaves of the honey-suckle appear ruddy, in the laurel, greenishⁿ. 15. The leaves of wood-sorrel are very much perforated, and moist, as it were, with a perpetual dew^o. 16. Fever-feu appears all over spotted

^z Id. Obs. 87.^a Id. Obs. 71.^b *Christ. Lange de Morbillis Disput. Lips. 1660. habita §. 61. ——— 67.*^c *Jour. des Scav. Tom. II. p. 484.*^d *De Luc. & umbr. part. I. c. 12. f. 156.*^e *Borel. Obs. Micr. 86.* ^f Id. Obs. 4.^g Id. Obs. 15. *Kircher Ars magna L. X. p. 2. c. 8. §. 2. f. 834.*^h *Kircher l. c. Borel. Obs. 25.* ⁱ *Borel. Obs. 46.*^k Id. *ibid.*^l Id. Obs. 63.^m Id. Obs. 5.ⁿ Id. Obs. 63.^o Id. Obs. 52.

spotted^p. 17. If the seed of a *French* bean or almond be steep in hot water and open'd, and its bud be cut away with a fine needle, you will find in it the appearance of the plant, in the same manner as in the buds of trees and in the eyes of seeds the rudiments of plants are seen^q. 18. In examining the filaments of the leaves of the *orchis*, the flowers appear all over interwoven with very small images of a human form^r. 19. Vinegar, made from wine, in the microscope exhibits eels, which wriggle and move pretty fast therein^s: And they are sometimes seen, even by a quick eye, when view'd in the sun without a microscope; which was observ'd in the last century by *Andreas Baccius*^t; or if vinegar be mixt with clear water, somewhat long worms are observ'd to float in the glass, and they are manifestly seen, according to *Erasmus Bartholin*^u. Thus *Franciscus Pona*^v saw worms of a silver colour swimming like so many small fishes in vinegar, which upon withdrawing the vinegar, would stick to the sides of the glass. *Job. Nardius*^x relates, that in some sorts of vinegar he only observ'd worms by the microscope, namely, in such vinegar as is made from palled and weak wines, but not in that made from generous wines: Yet *Borellus*^y does not exclude even the strongest vinegar; and *Panarollus*^z affirms, that they are found in all sorts of vinegars, and that the stronger these are, the more numerous are the worms; which are of an oblong figure, slender, with a small head; and that they are kill'd by adding treacle to the vinegar.

1. The *acari* or *sirones*, which are small worms lodging in pustules on the human skin, being taken out, are very small insects resembling a white point, but view'd in the microscope, they appear to be hairy animals, entirely like a bear^a. *Borellus* makes them resemble a hedge-hog^b; and thinks it surprising, that in so small an animal and almost no bigger than a point, all the organs, as the feet, nerves, eyes and other parts of an animal, may be seen. *Augustus Hauptman* in a letter to *Kircher*, inserted in a treatise of his *de thermis Wolckensteinensibus*, p. 200, gives them a monstrous figure, with many oblong tails behind, and represents them like the mites of cheese. 2. The commissures and articulations of the little bones of a bee, its small claws, the variegated colours of its wings, its distinct rows of teeth, with which it sips the flowers, are seen in the microscope^c. By this instrument we observe, that the bee carries the wax externally on his thighs, and the honey in his stomach, which he afterwards discharges, a little alter'd and like a chyle, as young pigeons

In the animal kingdom, and first on insects.

^p Id. Obs. 63. ^q Id. Obs. 17.

^r *Kircher Mund. subter.* L. XII. f. 1. c. 9. f. 349.

^s *Borel. Obs.* 1. *Job. de May* in cap. 4. *Goedart. de insect.* p. 52. *Dominic. Panarol. pent.* 4. Obs. 36.

^t *Natur. Vinor. histor.* l. 1. c. 23. *Er Thermæ* l. 4. c. 21.

^u *Thom. Bartholin. Cent. IV. Obs. Hist.* 13.

^v 8 prol. Saturn.

^x *Noctes geneal.*

^y noct. 1. p. 75.

^z *Obs.* 1.

^a l. c.

^b *Kircher scrutin. pest.* f. 1. c. 7. exp. 4.

^c Obs. 21.

^d *Fontan. Obs.* 10.

pigeons do: For, if a bee be cut into two, you immediately observe a vesicle of honey like a grain, which if suck'd is found sweet^d. *Kircher* also observes^e, that if the excrements of a bee be examin'd with a microscope, that at first they appear like a number of small bags, and immediately upon breaking them, a number of small worms, some of which resemble caterpillars and others, perfect bees with their wings. 3. Silk-worms seem to discharge the silk not from their mouths, but from nipples with which their back is all over cover'd^f. 4. In cater-pillars the hairs and colours appear finer than in fables and velvets^g: And on the back towards the tail they have three red navels; and some only two, from which they discharge some red matter^h. 5. An ant in a microscope appears as big as a crab, its mouth is pointed and sharp, like a pair of pincers, in whose internal parts its teeth appear white, and disposed in a long row; from the top of its head are projected two oars, as it were, all over shaggy; its eyes are black like floes; it has six feet, supplied with joints; its head consists of various and distinct parts; its body resembles an egg, and roll'd round, as it were, with several swathsⁱ: Yet its eyes are with difficulty distinguish'd on account of their blackness; but they are better seen in white ants, whose eyes are very black^k. 6. If butterflies be included in a glass along with proper plants, by a natural instinct they fly to each other, and they together discharge an excrement like the eggs of fleas, which if examined by a microscope, in a little time they are animated into new worms or *eruceæ*, and these into *aurelia's*, and at length into young butterflies^l. 7. A gnat, says *Hieronimus Sirsalis*, appears like an elephant; its sharp stings like a dart; and its flexible trunk, and its small legs are magnified to a great degree. 8. The hook'd claws of a fly are sharp, and very like those of a cat; its wings are beautifully colour'd and variegated with small spots; the arteries, the articulation of the bones, the veins and the blood moving therein, and the nerves in this very minute animal are clearly seen^m. The eye of a fly consists of 3000 letticesⁿ. The structure of its sting and its foot are excellently well describ'd by Dr. *Hook*^o. The dead bodies of flies or their excrements, macerated in mead, and warmed a little before a gentle fire upon a plate, appear at first by the microscope to be imperceptible worms; and then getting wings, they become little flies, and at length they sensibly grow into perfect ones^p. 9. A spider is armed with bristles like a boar; its eyes are disposed in an ineffable manner; four

on

^d *Borel. Obs. medico-physic. Cent. I. Obs. 10.*

^e *Mund. subter. L. XII. f. 2. c. 2. exp. 1.*

^f *Mey in Goedart de Insect. not. in c. 4. p. 54.*

^g *Borel. Obs. Micr. 55.*

^h *Id. Obs. 62.*

ⁱ *Fontan. Obs. 3. p. 149. Borel. Obs.*

Micr. 48.

^k *Borel. Obs. 34.*

^l *Kircher L. XII. Mund. subter. f. 2. c. 3. f. 360.*

^m *Fontan. Obs. 4. — Borel. Obs. 49.*

ⁿ *Borel. Obs. 33.*

^o *Journ. des Sçav. T. II. p. 484. Ibid. p. 481.*

^p *Kircher Mund. subter. L. XII. f. 2. c. 4. f. 361.*

on its forehead, two on the crown of the head; one to the left, the other to the right, and afford light to the whole body; its teeth are very like thick hairs, the little bones of the feet have different articulations: And what is surprizing, it has very black claws, not unlike an eagle's^q. *Borellus* observ'd eight eyes in some spiders (but not in all of them) dispos'd on the forehead in form of a half moon; six in the first row, and two in the second; and these eyes are furnish'd with their crySTALLINE humours: Whence, on account of their sharp-sightedness, it is that they so nimbly hunt down flies. All its body is covered over with hair; it spins its web out of its mouth; its tail, or the eminencies thereon are moveable. *Borellus* observ'd^r by a small microscope at a candle, 40 eggs in a small purse of its web, hanging like so many pearls; and in these a black point, the beginning of the heart. 10. A flea is a surprizing sight; its intestines are distinguish'd and arranged in a wonderful manner. *Fontana*^f has observ'd more than once, that upon pricking a flea with a fine needle, eggs would burst out of the wound, and from these eggs were discharg'd half-form'd young ones. A flea, says *Kircher*^t, is no other than a locust without wings; for, in the smallest animals, nature has exhibited to us lions, bulls, horses, dogs, cats, asses, eagles and geese. *Borellus* is of opinion, that a flea is like a shrimp or craw-fish^u; and wounds with its many and uniform strong stings; especially those in its thighs and legs, and with its scaly tail: As to the legs of a flea, (of which it has six) and their shape, *vide* Dr. *Hook*'s account in the *Journal des Sçavans*^w: In fine, from its eggs is observ'd to proceed a great number of fleas, which at first are white; but afterwards are covered with a black case^x. 11. No one has better describ'd and delineated the louse, than Dr. *Hook*, who in the *Journal des Sçavans* has given a draught of its eyes, breast, snout, feet, &c.^y. And *Borellus*^z has observ'd a wonderful transparency in it, by means of which the circulation of the blood in its heart, may be seen with admiration; and if it be engag'd with a flea, the sight appears like that of two wild beasts on the amphitheatre: So that the motion and ebullition of the blood, caus'd by their rage, may be plainly seen. 12. *Nicolaus Tulpius*^a caus'd thus delineate, as magnified in the microscope, a worm discharged by urine, that was as big as a barley-corn; in its head and pair of horns it resembled a beetle, only that its snout was sharp and smooth; its belly consisted of 10 articulations, as if it was jointed; from each of which on both sides proceeded a hairy and rough leg, like that of a beetle: Its tail consisted of three articulations, of which the last but one about its extremity sends forth from a small hole on each side, two hairs; but the last articulation sends out three, from whose middle an incurvated tail does project like a beetle's. 13. The same Author delineates another worm discharged by

^q *Fontan. obs.* 6.

^r *Obs.* 20.

^f *Obs.* 2.

^t *Ars magn.* f. 156.

^u *Obs.* 12.

^w *T. II* p. 487. §. 8.

^x *Kirch. Mund. Subter.* L. XII. f. 2. c. 7. f. 371.

^y *T. II.* p. 487 §. 8. *T. II.* p. 482. *seq.*

^z *Obs.* 11.

^a *L. II. obs.* 42. p. 171.

by urine, of the thickness of an ordinary thread, and in length scarce the breadth of the little finger: This insect, magnified in the microscope, exactly exhibits a caterpillar, jointed like a coat of mail, with a very small sharp head; and forwards with only four feet on each side.

2. On Fishes.

The scales of fishes appear distinguish'd by several circular lines; and in that part where they adhere to the skin, divided up and down by several lines and points.

3. On Birds.

1. In the treadle of an egg we observe in a few days after incubation an entire chick formed, as also the motion of the heart ^b. *Kircher* in his treatise *de luce* ^c, explains this more at large. Take, *says he*, an egg and open it carefully on the third day after incubation; and upon viewing the yolk with a microscope, the form of the heart will appear manifestly in it, alive like a concreted drop of blood, and moving in a surprising manner, with ramifications full of blood proceeding from it on all sides, as rays from the sun, or streams from a fountain: None other of the members appear till after four days more; when the rudiments, as it were, and cloudy substance of the spine, reaching from the brain, appears; and then successively the rest of the members. 2. That force in ducks and hens, whereby digestion is performed in them, is surprising: Upon opening their stomachs a few hours after feeding them with solid crystal-balls, they were seen encompass'd with a coat, which, view'd by the microscope, shew'd nothing other than a small quantity of a very subtile and impalpable dust of glass ^d.

4. On terrestrial animals, and their parts.

1. Snails are not only furnish'd with very sharp teeth; but also with eyes in their horns, which draw out; we observe the black of them ascend from the lower part of the horns, or from the brain to the upper parts, when they have a mind to move and direct their steps, whither their horns are turned; they have only one ear, and in their bodies we find a liver, veins, arteries, &c. 2. Flesh expos'd over night to the rays of the moon, upon applying a microscope to that part where the lunar rays fall, it is found to swarm with maggots of different sizes ^e. 3. In stale hog's lard we find not only hairy maggots with eyes, but numberless other *animalcula* of a different figure^f. 4. Milk, especially if sour, is full of worms; and this *Kircher* likewise testifies ^h: And hence he accounts for worms in children; because they feed for the most part on milk ⁱ. 5. The dust, which grows on cheese, exhibits a prodigious animal, whose brows are gently drawn, and as it were, with a pencil; the large balls of its eyes are plainly blackish, and give a large light; it is armed with nails and claws;

^b *Borel. obs.* 18. ^c *L. 2. p. 1. c. 10. f. 151.*

^d *Acad. del Cimento Nat. exper. f. 268.*

^e *Kirch. de peste f. 1. c. 7. § 2. exper. 1. p. 70.*

^f *Borel. obs.* 14. ^g *Id. obs.* 2.

^h *Mund. subter. L. XII. f. 1. c. 10. f. 352. & sect. 2. c. 1. f. 357.*

ⁱ *Id. ibid. c. 7. f. 370.*

claws; its body is all over finely colour'd; it creeps, eats and moves, and is as big as a man's nail; its back is entirely rough and scaly, variegated with a great many stars, and it is armed with thick and strong bristlesⁱ; its motion and eating is observ'd; nay, even the discharge of its excrements; it resembles a hedge-hog, with little horns, and three remarkable stings in its tail^k.

1. In the human *epidermis* appear pieces of net-work^l. 2. The smoothest skin of a woman appears rough and scaly, as it were^m; and almost every where in the pores there are hairs seenⁿ. 3. Human hair, expos'd to the microscope, exhibits a rounded and channel'd girdle; nay, upon pulling out a hair, we observe the pores of the skin, thro' which the sweat and hair come out, and even a thick and earthy humour, and the viscous root of the hair^o. The hairs are concave like so many tubes; so as to resemble the quills of birds; and in them are seen various colours like a rainbow^p. In the *Journal des Sçavans* Dr. Hook affirms^q, that they are round and thicker towards the end, than at the root, and that from the one end to the other, they are hollow like a horn. 4. The nits of the head appear like so many round eggs, full of juice and transparent^r. 5. In the pores of the nose of several men, by the microscope we find worms of a black head, like so many spiders in their holes^s: Whence we may account for that remarkable itching in the noses of children, that have the worms. 6. The lines in the fingers, which are almost invisible to the naked eye, are found by the microscope to be like the furrows of a field full of dirt^t: And by this instrument the latent lines in the palm of the hand are discover'd^v. 7. The nails appear gaping in such manner, as not ill to represent the widest open mouth of a wild beast^w. 8. In the *parenchyma's*, as the heart, the lungs, the liver and kidneys, is seen a *plexus* of little organs and fibres like so many sieves, by which different liquors are secreted by nature according to the figure of their pores^x. 9. In a microscope the human blood appears verminous, of which more in a particular observation. 10. *Bellini*^y asserts, that in the kidneys throughout their whole mammillary substance the *serum* is pour'd from numberless small orifices and pores into the *pelvis*; if these filaments be compress'd from the extremity that regards the *pelvis*, and then view'd, they exhibit a water plentifully ouzing out: This is much more easily discover'd by the microscope; for, then compressing the *tubuli*, the urine is very plainly seen gushing out, as from so many little siphons^z. 11. The mouths of those very minute vessels which pour the blood from the descending artery into the emul-

ⁱ Fontan. obs. 1. ^k Borel. obs. 27. ^l Borel. obs. 88. ^m Id. obs. 97. ⁿ Id. obs. 13.
^o Fontan. obs. 8. ^p Borel. obs. 23. — Panarel. Pentit. IV. obs. 34. — Th. Bartholin
Anat. reg. L. IV. c. 1. ^q T. II. p. 485. ^r Borel. obs. 10. ^s Id. obs. 30. ^t Id. obs. 13.
^v Id. obs. 94. ^w Id. obs. 40. ^x Id. obs. 76. ^y De struct. renum, p. 68. ^z Ibid. p. 70.

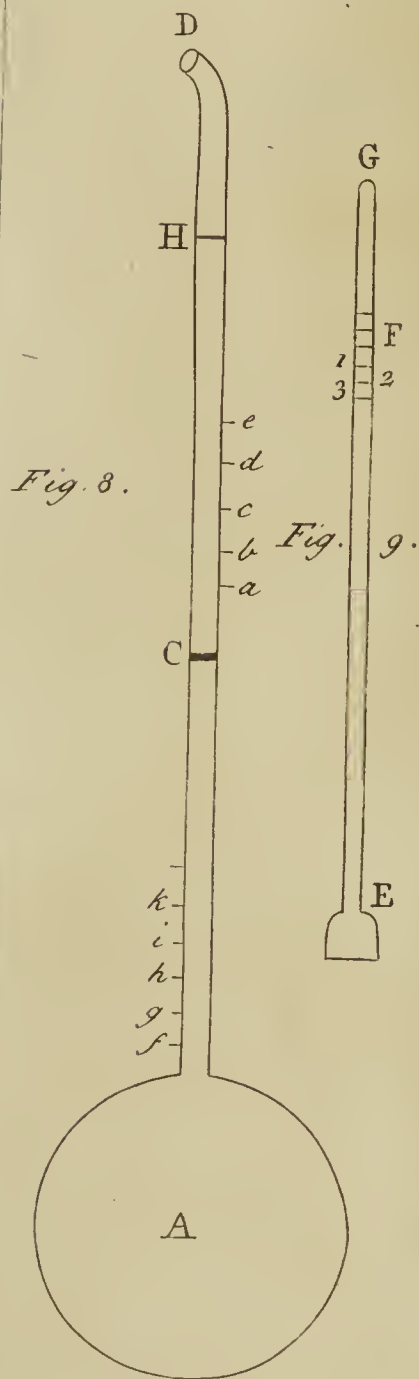
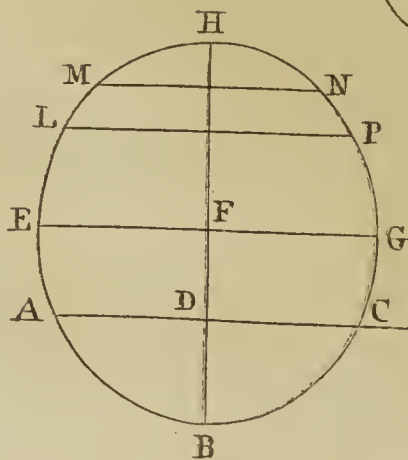
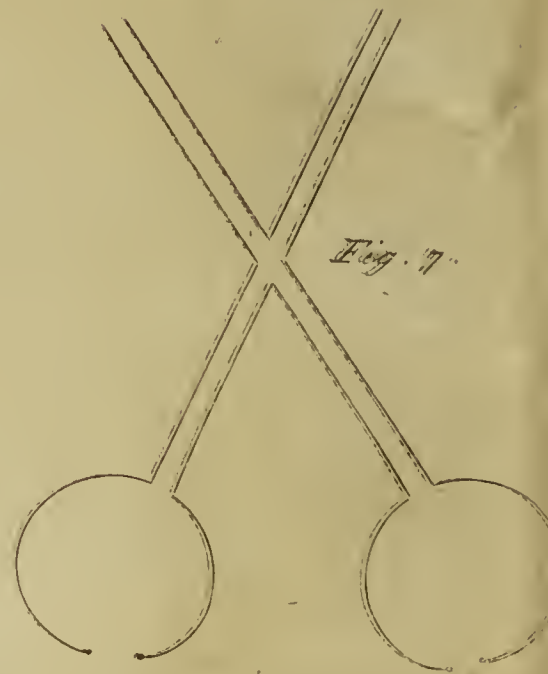
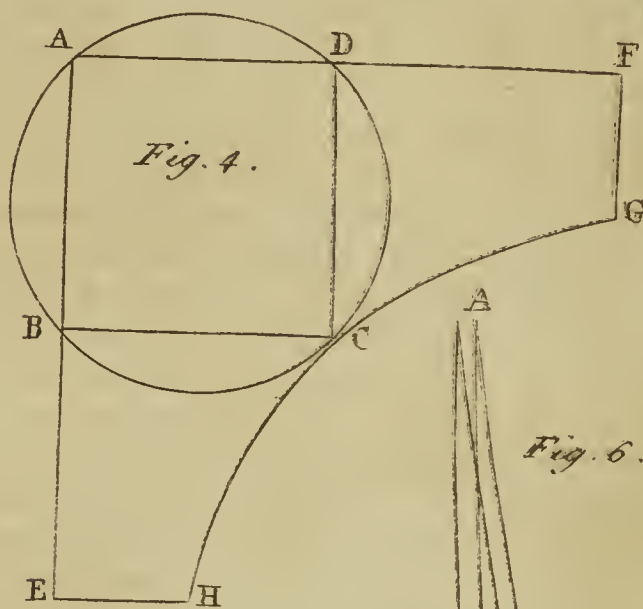
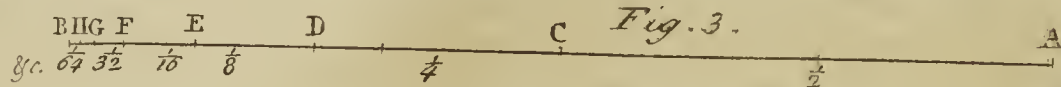
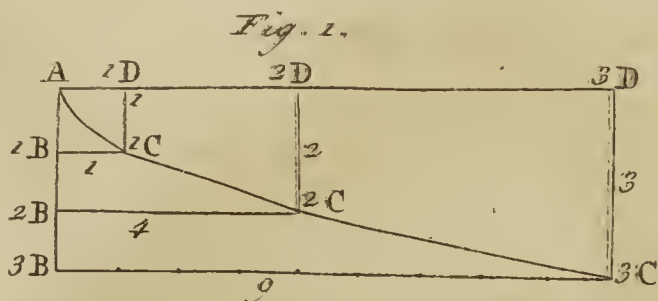
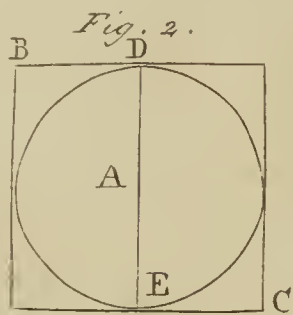
emulgent and convey it to the surface of the kidneys, are not perceptible to the naked eye; yet both reason persuades us, and the microscope confirms that there are such^a. 12. On the eminencies of the tongue, whose roots are furnish'd with nerves, *Bellini* in his treatise *de gustus organo* discover'd by the microscope a number of flat holes^b. 13. Dr. *Willis*^c discover'd by the microscope, that the nerves are compact and firm bodies; his words are to the following purpose; "the nerves are not perforated like the arteries and veins: For, their substance is not only impervious to any probe, but by the microscope we discover no cavity in them". And tho' in the same place, and afterwards in *Page* 206 he reckons both the olfactory and optic nerves to be *tubuli*; yet he asserts that these cavities do not properly belong to them as they are nerves, but on another account, to wit, for the influx of the animal spirits.

2. On the diseases of men.

1. *Borellus*^d shows from *Alstedius*, that in time of a pestilence the air is full of little worms, which are swallowed down in respiration, and which are produced from the corruption of the air. In the same manner *Kircher*^e holds, that worms propagate a pestilence, tho' they are so very small that they cannot be seen but by the most exquisite microscope, and are rather to be call'd atoms; and when expell'd out of the body by sudorifics they fly away by the least breath of air; whatever body they meet with, they firmly adhere to it and insinuate into its inmost pores. M. *De Monconys*^f asserts, that in pestilential pustules there was found a great number of little insects, which after they had got wings flew away and spread every where that contagious disease. 2. In spotted fevers little worms are observed to eat through the capillary vessels and thus together with the extravasation of the blood they cause spots and *petechiæ*^g. 3. Dr. *Christian Lange*^h asserts, that the pustules in the small pox are nothing other than the receptacles and lodgements of verminous *effluvia*; and these worms have a common figure with the *acari*ⁱ; they are many-footed and have sharp snouts, with which they bite through the skin, and by the painful itching, cause an afflux of humours^k. *Borellus* likewise holds, that there are worms in the small pox^l. 4. In the itch likewise worms are seen^m. 5. In venereal blotches *Kircher* has seen worms like snails; and so broody, that in half an hour they brought forth 50 at a birthⁿ. 6. In those troubled with the gravel, the little white sands appear opaque in the microscope, and not transparent; very rough and pricking, seeing their extremities are pointed; but the red or the yellow represent precious stones like the *sardonix*; and smooth, either of an oval or round figure, and friable^o. 7. In the glans of a venereal patient, *Borellus* found a little insect like a snail^p.

The

^a *Ibid.* p. 74, 75. ^b *Journ. des Sçav.* Tom. II. p. 460. ^c *Descript. nervor.* c. 19. p. 179. edit. Amstel. ^d *Obs.* 79. ^e *De peste* f. 2. c. 4. p. 293. ^f *In voyag.* Tom. II. p. 178. ^g *Hauptman epist. ad Kircher. de vivâ mort. imag.* p. 200. ^h *Disp. de micribil.* § 59. ⁱ *Id. ibid.* § 68. ^k *Id. ibid.* § 69. ^l *Obs.* 31. ^m *Id. Obs.* 32. ⁿ *Mund. subter.* L. XII. f. 1. c. 16. f. 352. ^o *Panarol. Pent.* IV. *Obs.* 35. ^p *Obs.* 53.



The Filegian Cotton. P. 45.

The true proportion of the circle to the circumscrib'd square, in rational numbers. By G. G. Leibnitz. From the Acta Eruditorum, An. 1682. p. 41.

Translated from the L A T I N.

Geometricians have at all times attempted to investigate the proportions of curves to right lines; and yet this is still far from being in our power, even by algebra, according to the methods hitherto known; nor can these problems be reduced to algebraical equations; and yet they are excellently useful, especially in reducing mechanics to pure geometry, as is well known to those few Mathematicians, who have enter'd deeper into these matters. *Archimedes* was the first, as far as we know, who found out the ratio between a cone, a sphere, and a cylinder of the same base and height, to wit, that of 1, 2, 3: So that the cylinder is in a triple ratio of the cone, and in a sesquialteral ratio of the sphere: Whence he order'd the sphere and cylinder to be engrav'd on his monument: He also discover'd the quadrature of the parabola. In our days a method is found of measuring numberless curvilinear figures, especially when the ordinates BC are in any multiply or submultiply ratio, either direct or inverse, of the abscissa's AB or CD: For the figure ABCA will be to the circumscrib'd rectangle ABCD, as 1 to a number increas'd by unity, and which expresses the multiplication of the ratio; as for instance, because in the parabola, the abscissa's AB or DC being as the natural numbers 1, 2, 3, &c. the ordinates BC are as their squares 1, 4, 9, &c. or in the duplicate ratio of these numbers; and then the number expressing the multiplication of the ratio will be 2: The figure ABCA will, therefore, be to the circumscrib'd rectangle ABCD, as 1 to 2 + 1, or as 1 to 3; or the figure will be $\frac{1}{3}$ of the rectangle. If AB or CD remain natural numbers, and BC be cubes, 1, 8, 27, &c. (as in the cubical paraboloid) the ratio of the ordinates would be triplicate of the ratio of the abscissa's; the figure, therefore will be to the rectangle as 1 to 3 + 1, or 4, or $\frac{1}{4}$. But if DC are squares, BC cubes, or the ratio of BC be triplicate-subduplicate of the ratio of DC, the figure ABCA (the cubico-subquadratic paraboloid) will be to the rectangle ABCD, as 1 to $\frac{3}{2} + 1$, or make $\frac{5}{2}$ of the rectangle. In the reciprocal, the sign— is prefixt to the number expressing the multiplication of the ratio.

But the circle could not hitherto be reduced to these laws, tho' attempted by geometricians of all ages; for, hitherto a number could not be found, that would express the ratio of the circle A to the circumscrib'd square BC, which is the square of the diameter DE; nor could the ratio of the circumference to the diameter be found, which is quadruple of the ratio of the circle to the square. *Archimedes*, indeed, shows a method by inscribing and circumscribing polygons about a circle (because it is greater than the inscrib'd and less than the circumscrib'd) of exhibiting the limits,

H 2

between

The ratio of curves to right lines not discoverable by common algebra.

A method of measuring numberless curves. Plate II. Fig. 1.

The ratio of the circumference of a circle to its diameter by approximation. Fig. 2.

between which the circle falls, or of giving approximations; to wit, that the ratio of the circumference to the diameter is greater than 3 to 1, or than 21 to 7, and less than 22 to 7. Others, as *Ptolemy*, *Vieta* and *Metius* have prosecuted this method; but above all *Ludolphus Van Ceulen*, who has shewn that the circumference is to the diameter as 3.14 159 265 358 979 323 846, &c. to 1.00000000000000000000.

Approximations
not entirely satis-
factory.

But such approximations, tho' of use in practical geometry, afford nothing that can satisfy a mind eager on truth; unless the progression of such numbers to be continu'd *in infinitum* can be discover'd. Many, it is true, have pretended to a perfect quadrature of the circle, as *Cardinal Cusan*, *Orontius Fineus*, *Joseph Scaliger*, *Thomas Gephyrander*, and *Thomas Hobbes*; but all of them falsely.

The quadrature
of the circle dis-
coverable in a
four fold manner.

But because I find, that many are not sufficiently aware of what is requir'd to be done; we are to observe, that the quadrature, or the conversion of a circle into an equal square, or any other rectilinear figure (which depends on the ratio of the circle to the square of the diameter, or of the circumference to the diameter) may be understood to be fourfold; to wit, either by calculation, or by linear construction, and both, either accurate or nearly so: The quadrature, by accurate calculation, I call the analytical; but that by accurate construction, the geometrical; by calculation nearly true, we have the approximation; by construction nearly true, the mechanism. *Van Ceulen* has farthest of all carried the approximation. *Vieta*, *Huygens*, and others, have given us excellent mechanisms.

The quadrature
of the circle in
rational numbers.

The accurate geometrical construction may be had, by which not only the entire circle may be measur'd, but any sector or arch thereof by an exact and ordinate motion, but such as may agree to transcendental curves, which are otherwise erroneously call'd mechanical; since they are equally geometrical as those commonly so esteem'd, tho' they are not algebraical, nor reducible to equations algebraical, or of a determinate degree: For, they have their peculiar degrees, tho' not algebraical, yet analytical. The analytical quadrature, or that by accurate calculation, may again be divided into three kinds; to wit, the analytical transcendent, the algebraical and the arithmetical. The analytical transcendent is obtain'd among others by equations of an indefinite degree, hitherto consider'd by no one; as if $X^x + X$ be = 30, and X be sought, it will be found to be 3; because $3^3 + 3$ is $27 + 3$, or 30. The algebraical expression is by vulgar tho' irrational numbers, or by the roots of common equations, which is indeed impossible for the general quadrature of the circle and its sector. There now remains the arithmetical quadrature, which is perform'd by series's exhibiting the exact value of the circle in a progression of terms, first rational, such as I shall here propose: I, therefore, found (supposing the square of the diameter to be 1,) that the area of the circle would be $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13} - \frac{1}{15} + \frac{1}{17} - \frac{1}{19}$, &c. to wit, the entire square of

of the diameter diminish'd (lest the value should be too much) by $\frac{1}{3}$; and again encreased (because too much was taken away) by $\frac{1}{7}$; and again less'n'd (because we added too much) by $\frac{1}{7}$, &c. The first quantity will, therefore, be too great, yet the error less than $\frac{1}{3}$; the second, $\frac{1}{1} - \frac{1}{3}$, too little, but the error less than $\frac{1}{7}$; the third, $\frac{1}{1} - \frac{1}{3} + \frac{1}{7}$, too much, but the error less than $\frac{1}{7}$; the fourth, $\frac{1}{1} - \frac{1}{3} + \frac{1}{7} - \frac{1}{7}$ too little, but the error less than $\frac{1}{7}$, &c. The whole series, therefore, contains all the approximations together, or the values both greater or less than the truth: And continuing the series, the error will be less than a given fraction, and consequently less than any assignable quantity; wherefore the entire series expresses the exact value: And tho' the sum of the series cannot be express'd by one number, and the series be continu'd *in infinitum*; yet as it consists of one law of progression, the whole is sufficiently perceiv'd by the mind; for, seeing a circle is not commensurable to a square, it cannot be express'd by one number, but in rationals it ought necessarily to be exhibited by a series: And indeed, if *Van Ceulen* could have given us a rule whereby the numbers 314 159, &c. could have been continu'd *in infinitum*, he would have given us in integers the exact arithmetical quadrature, which I here give in fractions.

But lest any one but little conversant in these matters should think that a series, consisting of an infinite number of terms, cannot be equal to a circle, which is itself a finite quantity; we are to observe, that many series's, which are infinite in the number of the terms are in their sum finite quantities: As an easy example, take a series decreasing from unity in this duple geometrical progression $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64}$, &c. *in infinitum*, and the whole makes no more than 1: For, in the right line AB, which suppose to be 1, AC will be $\frac{1}{2}$, and bisecting the remainder CB in D, you will have CD, $\frac{1}{4}$; and bisecting the remainder DB in E, you will have DE, $\frac{1}{8}$; and bisecting the remainder EB in F, you will have EF, $\frac{1}{16}$; and thus you may proceed *in infinitum*.

The sum of an infinite series finite.

Plate II. Fig. 3.

Many remarks might be made on this quadrature, but I must not omit one, *viz.* that the terms of my series $\frac{1}{1} - \frac{1}{3} + \frac{1}{7} - \frac{1}{9} + \frac{1}{7} - \frac{1}{9}$, &c. are those of an harmonical progression, or in a continu'd harmonical proportion, as will appear upon trial. And even a series made by skipping, as $\frac{1}{1} - \frac{1}{7} + \frac{1}{9} - \frac{1}{13} + \frac{1}{17}$, &c. is likewise in harmonical progression; and $\frac{1}{3} - \frac{1}{7} + \frac{1}{11} - \frac{1}{15} + \frac{1}{19}$, &c. is likewise a series of harmonical proportionals. Since, therefore, the circle is $\frac{1}{1} + \frac{1}{7} + \frac{1}{9} + \frac{1}{13} + \frac{1}{17}$, &c. $- \frac{1}{3} - \frac{1}{7} - \frac{1}{11} - \frac{1}{15} - \frac{1}{19}$, &c. by subtracting the latter partial series from the former, the circle will be the difference of two series's in harmonical progression: And because the sum of any number or terms in harmonical progression, how many soever, may by some compendium be obtain'd, you may hence deduce (if after *Van Ceulen's* there were occasion for any) compendious approximations.

The terms of M. Leibnitz's series in harmonical progression.

If

A new series for
the circle.

If any one would take out the terms affected with the sign $-$ in my series, by adding together the two next terms, as $+\frac{1}{1} - \frac{1}{3}$, also $+\frac{1}{7} - \frac{1}{9}$, and likewise $+\frac{1}{9} - \frac{1}{11}$ and $+\frac{1}{13} - \frac{1}{15}$, and $+\frac{1}{17} - \frac{1}{19}$, &c. he will have a new series for the magnitude of the circle; to wit, $\frac{2}{3}$ (*i. e.* $\frac{1}{1} - \frac{1}{3}$) $+\frac{2}{35}$ (*i. e.* $\frac{1}{7} - \frac{1}{9}$) $+\frac{2}{99}$ (*i. e.* $\frac{1}{9} - \frac{1}{11}$): The inscrib'd square, therefore, being $\frac{1}{4}$, the area of the circle will be $\frac{1}{3} + \frac{1}{35} + \frac{1}{99} + \frac{1}{195} + \frac{1}{323}$, &c. but the numbers 3, 35, 99, 195, 323, &c. by skipping are taken out of the series of square numbers 4, 9, 16, 25, &c. less by unity: Whence the series becomes 3, 8, 15, 24, 35, 48, 63, 80, 99, 120, 143, 168, 195, 224, 255, 288, 323, 360, 399, &c. out of the members of which series every fourth after the first is a number of my series: But I have found (which is remarkable) the sum of this infinite series $\frac{1}{3} + \frac{1}{8} + \frac{1}{17} + \frac{1}{24} + \frac{1}{35} + \frac{1}{48} + \frac{1}{63} + \frac{1}{80} + \frac{1}{99}$ to be $\frac{3}{4}$; nay, and by taking them by single skipping, to wit, $\frac{1}{3} + \frac{1}{15} + \frac{1}{35} + \frac{1}{63} + \frac{1}{99}$, &c. the sum of that series makes $\frac{2}{4}$ or $\frac{1}{2}$: But if again from this we take out the terms by single skipping, to wit, $\frac{1}{3} + \frac{1}{35} + \frac{1}{99}$, &c. the sum of that series will be the semicircle, supposing the square of the diameter to be 1. But because by the same means the arithmetical quadrature of the hyperbola is obtain'd, I shall here give the reader the whole harmony.

The quadrature
of the hyperbola
and circle in one
view.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	4	9	16	25	36	49	64	81	100	121	144	169	196	225	256	289	324	361	400	
0	3	8	15	24	35	48	63	80	99	120	143	168	195	224	255	288	323	360	399	&c.
	$\frac{1}{3}$	$\frac{1}{8}$	$\frac{1}{15}$	$\frac{1}{24}$	$\frac{1}{35}$	$\frac{1}{48}$	$\frac{1}{63}$	$\frac{1}{80}$	$\frac{1}{99}$	$\frac{1}{120}$	$\frac{1}{143}$	$\frac{1}{168}$	$\frac{1}{195}$	$\frac{1}{224}$	$\frac{1}{255}$	$\frac{1}{288}$	$\frac{1}{323}$	$\frac{1}{360}$	$\frac{1}{399}$	&c. = $\frac{3}{4}$
	$\frac{1}{3}$	$\frac{1}{15}$	$\frac{1}{35}$	$\frac{1}{63}$	$\frac{1}{99}$	$\frac{1}{143}$	$\frac{1}{195}$	$\frac{1}{255}$	$\frac{1}{323}$	$\frac{1}{399}$	$\frac{1}{486}$	$\frac{1}{578}$	$\frac{1}{685}$	$\frac{1}{807}$	$\frac{1}{945}$	$\frac{1}{1100}$	$\frac{1}{1275}$	$\frac{1}{1472}$	$\frac{1}{1695}$	&c. = $\frac{2}{4}$
	$\frac{1}{3}$	$\frac{1}{8}$	$\frac{1}{24}$	$\frac{1}{48}$	$\frac{1}{80}$	$\frac{1}{120}$	$\frac{1}{168}$	$\frac{1}{224}$	$\frac{1}{288}$	$\frac{1}{360}$	$\frac{1}{448}$	$\frac{1}{540}$	$\frac{1}{648}$	$\frac{1}{768}$	$\frac{1}{900}$	$\frac{1}{1056}$	$\frac{1}{1232}$	$\frac{1}{1440}$	$\frac{1}{1680}$	&c. = $\frac{1}{4}$
	$\frac{1}{3}$	$\frac{1}{35}$	$\frac{1}{99}$	$\frac{1}{195}$	$\frac{1}{323}$	$\frac{1}{486}$	$\frac{1}{685}$	$\frac{1}{945}$	$\frac{1}{1275}$	$\frac{1}{1695}$	$\frac{1}{2240}$	$\frac{1}{2916}$	$\frac{1}{3675}$	$\frac{1}{4536}$	$\frac{1}{5500}$	$\frac{1}{6580}$	$\frac{1}{7776}$	$\frac{1}{9090}$	$\frac{1}{10540}$	&c. = to
	$\frac{1}{3}$	$\frac{1}{48}$	$\frac{1}{120}$	$\frac{1}{195}$	$\frac{1}{288}$	$\frac{1}{399}$	$\frac{1}{528}$	$\frac{1}{675}$	$\frac{1}{840}$	$\frac{1}{1023}$	$\frac{1}{1224}$	$\frac{1}{1448}$	$\frac{1}{1695}$	$\frac{1}{1968}$	$\frac{1}{2268}$	$\frac{1}{2592}$	$\frac{1}{2940}$	$\frac{1}{3312}$	$\frac{1}{3714}$	&c. = to

the circle ABCD
whose inscrib'd square
the hyperbola CBEHC
whose power ABCD } is $\frac{1}{4}$.

Plate II. Fig. 4.

To the asymptotes AF and AE at right angles to each other, describe the hyperbola GCH, whose vertex is C, but ABCD its inscrib'd power or square, which is always equal to the rectangle made of any ordinate EH and its abscissa AE; about this square describe a circle, and suppose the hyperbola be continued in such manner from C to H, that AE be double of AB; then supposing AE to be 1, AB will be $\frac{1}{2}$, and its square ABCD $\frac{1}{4}$; and the circle, whose inscrib'd power is ABCD, will be $\frac{1}{3} + \frac{1}{35} + \frac{1}{99}$, &c. But the portion of the hyperbola (whose inscrib'd power is the same square $\frac{1}{4}$) CBEHC, which represents the logarithm of the ratio of AE to AB, (or of 2 to 1) will be $\frac{1}{3} + \frac{1}{48} + \frac{1}{120}$, &c.

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*An Experiment concerning the Optic Nerve, by Dr. Dan. Bernouilli.
From the Comm. Acad. Imp. Petrop. Tom. I. p. 314.*

Translated from the LATIN.

M. Mariotte on occasion of a controversy between him and M. Pecquet, about the immediate organ of vision, contriv'd an experiment to prove that a certain space in the middle of the *choroïdes* or the *retina*, as some would have it, is quite unfit to receive the image of objects. Upon which another dispute ensued: Whether this insensibility was owing to the perforation of the *choroïdes* by the optic nerve, or to a distinguishable *plexus* of blood-vessels in the *retina*. It was my opinion, that the best way of making a judgment hereon, wou'd be from the form, position and size of the space thus unaffected by the action of the rays of light; all which may be accurately determin'd thus.

To what the insensibility of a part of the *retina* is owing.

On an even floor, cover'd, for distinction sake, with black cloth, lay a piece of silver coin, as at O, and draw a strait line, as OA; then take a plumb-line, and holding one end thereof close to the right eye, let the other end down as near as may be to the floor, without touching it. Lastly, shutting the left eye, look steadfastly with the right, at the bottom of the plumb-line, and whilst you do thus, gradually advance your whole body to the left hand, in such sort, that the bottom of the plumb-line may be kept continually over the line OA: Thus proceeding, note accurately the place where you begin to lose sight of the object, suppose at C; then moving on again; note likewise carefully the point A, where you perceive the object again. Bisect the line AC in D, and having drawn the perpendicular BH, go over BH, as you did over OA, that is, observe diligently the points B and H, the limits, between which the plumb-line hanging, the object O disappears. Again, let BH be bisected in F by the perpendicular line GE, and in this also after the like manner find the points E and G; do the like in other lines LP, MN, &c. and thro' all these points draw the curve line HEBGH, which will be of such a nature, that as long as the eye looks at any point within the curve, the object at O will be quite invisible, but if the axis of vision be directed any where without the curve, it will that instant be seen. I made such an experiment myself, and having reduced my several quantities observed, to the length of my plumb-line, which I choose to call 100, I found $OC = 23$, $AC = 10$, $BD = 3$, $DH = 13$, and $EG = 14$: From whence it appears that the curve is nearly an ellipse, whose centre is in F, and the greater to the lesser axis, as 8 to 7.

An experiment to determine it. Plate II. Fig. 5.

I am now to shew how, from these observations, the position, form, and size of this insensible space may be determined, and this may easily be done; for since the lines AC, EG, LP, MN, HB, &c. are known,

The position and size of that insensible space how determined.

the

the lines analogous to them in the eye are determined. And though BH be greater than EG, yet will the lines analogous to them in the eye be equal; so that the elliptic figure will degenerate into a circular one; and the diameter of such little circles will be equal to a seventh part of the diameter of the whole bulb. Its centre will be distant seven twenty fifth parts of the bulb, from the point opposite to the pupil, and it will be also elevated a small matter above the middle of the eye; all which particulars answer so accurately to the optic nerve in the human eye; that M. Mariotte's opinion as to this point is confirmed beyond all doubt.

The insertion of
the optic nerve
lateral.

Now if the insertion of the optic nerve be the cause of M. Mariotte's phenomenon, 'tis evident why it was not inserted into the bulb directly against the pupil: For, then all objects would appear perforated in the middle, and so we should not see, what, in the present conformation of the eye, we look directly at*: But as this nerve is inserted laterally into the bulb, it thence follows, that we loose only such objects, as are placed sideways under a certain angle: Nor can one and the same object be ever invisible to both eyes at the same time, when the optic nerves are laterally implanted; which would always be the case if they were set in opposite to the pupil.

And perpendicular.

Another corollary, which I deduce from the same experiment, is this, that the optic nerve could not be otherwise inserted into the eye, than perpendicularly: For, the place of its insertion being of no use in vision, nature must have so provided that it should be the smallest possible; and it can be so no otherwise but by the nerves entering the bulb in a perpendicular direction.

If the nerves had been directed to the eyes in a right line from their origins; that is, from the branches of the *medulla oblongata*, this must necessarily have interfered with one or other of the foregoing *lemmata*: For, the origin of the optic nerve being in a manner opposite against the eye, as at A. 'Tis plain that the nerve itself (which I suppose perpendicular to the bulb or sphere of the eye) must be opposite to the pupil; but if the nerve had been inserted into the eye laterally at C, it had for that reason been oblique.

Plate II. Fig. 6.

The nerves, as they are not directed to the eye in a right line, but are first united, do thereby conform to both the *postulata*, as will appear upon a bare inspection of fig. 7.

Fig. 7.

If any one is for assigning this for the reason of the union of the optic nerves, I shall not scruple to be of his opinion.

A new

* This remark was made long since by Dr. James Keill, in his anatomy.

A new method of making Sea-water fresh. From the Breslaw Collection, July, An. 1717. Class V. Art. 2. p. 94.

Translated from the HIGH-DUTCH.

IT is, in general certain, that this process is not so much to be attempted by the way of correction, as was done in the year 1713, by the brackish water at *Tonningen*, by the admixture of cinnamon, sugar, &c. as principally, by the way of separation. In what manner the making sea-water sweet has been attempted at different times and lately in *England* by *Hauton*, and Dr. *Lister*, may be seen in the *Philosophical Transactions*^a and the *Acta Eruditorum*^b; which was partly by distillation and partly by filtration, yet always without the desired success; in regard these methods are together either too expensive, or at most too tedious; on which head Mr. *Boyle* is very full in his letter on the manner of making sea-water fresh.

The different methods of making sea-water fresh.

We may justly reckon among the new methods, that which M. *Reyher*, professor of law at *Kiel* attempted to render practicable by the way of congelation: On *February 6*, 1697, he caused make a hole in the ice that was a foot thick in the harbour of *Kiel*; and he found the ice there entirely fresh, and the water next below the ice without any brackish taste; but that water which he caused draw by means of a pipe, at a foot and a half beneath the ice, was a little brackish, and that taken up at the depth of five foot below the ice held so much salt, that four pounds apothecary weight yielded after boiling, an ounce and $3\frac{1}{2}$ scruples of a sharp salt.

M. *Reyher's* method.

Tho' this method, says M. *Reyher*, can be of no service in warmer climates, yet a method may be hit on of producing an artificial cold, by means of which sea-water may be render'd fit to drink^c: And in the *Philosophical Transactions*^d we have the manner of making this artificial ice. That method, probably, if it could be ascertained, is the easiest and most speedy, which *Walckort* has attempted by means of a certain pump; by which, when put into sea-water and pumped, sweet water may be immediately drawn out of it: And probably this contrivance is founded on the experiment alledged by Mr. *Oldenburgh* in the *Philosophical Transactions*, where a hollow and very close vessel of wax is let down into the sea, and into its cavity pure fresh water, separated from its salt, is made to soak: What an anonymous author mentions about the way of precipitation is curious; by it the salt, in form of a slimy substance, settles to the bottom, and the fresh water stands a-top; but he adds that this method is too expensive.

M. *Walckort's* method.

^a N^o 67. p. 2048, 2050 and N^o 156. p. 493.

^b Supplem. T. IV. Sect. 8. p. 364.

^c Vid. The Hamburg Remarks, Jan. An. 1699.—Paschii Invent. nov-antiq. c. 2. p. 661, 662.

^d N^o 15. p. 255—Act. Erud. Suppl. T. IV. §. 8. p. 363.

Some Indications of the Deluge in Sweden. By M. Emanuel Suedenborg. From the *Acta Literaria Sueciæ*, Trimestre tertium, An. 1721, p. 192.

Translated from the LATIN.

Indications of a deluge from figur'd stones, &c.

THAT the earth we now inhabit was formerly cover'd by the sea, appears very clearly both from figur'd stones and various petrified bodies, as also from other indications.

Not far from the town of *Uddevalla*, on a high mountain, is to be seen an entire tract, consisting of shells of different kinds: The same is also to be seen near *Stromstad* on a still higher mountain, and which is elevated 70 yards above the surface of the sea; as also in the islands *Cornia* and *Croust-bia*, from which the inhabitants burn an excellent kind of lime, with which they supply the whole country.

From different strata in Sweden.

In Sweden likewise are observable *strata* of very different kinds, as up and down in mines, and in one of *Scania*, not far from *Landscron*; and every where in the ruins of certain mountains, and also in the sloping sides of very high hills, as *Kinnekuelle*, *Billingen*, &c.

From the face of the northern parts.

That the ocean stood high above our earth seems to be more evidently concluded from the face of the northern parts, than from that of countries more southerly. Here we find entire tracts, fill'd, and as it were, pav'd with stones of a huge bulk and weight: And the higher the country lies from the sea, these stones are larger and more numerous. That stones of a great weight may be rolled and carried to a great distance, appears from the following hydrostatical considerations. 1. The weight of stone to water, bulk for bulk, is no more than 2 and $\frac{1}{2}$ to 1, and to salt-water still less. 2. Besides, it almost loses half its weight in water; and there remains but 1 and $\frac{1}{2}$. 3. Whence the weight of stone is not so sensible in the sea as in the air, seeing water is so heavy as almost to equal part of the remaining weight, that is, since the weight of stone in water is to water as 1 and $\frac{1}{2}$ to 1, in air it will be as 2000 to 1, if not more. 4. If, therefore, the waves agitate the sea at its bottom, as tempests do the atmosphere in its lower parts where we live; and if a column of sea-water be some hundred yards high, the motion and force of the fluctuating water at the bottom will be increas'd in the ratio of the height and of the bases: So that a wave of the sea, continu'd towards the bottom, has a greater force from its height than the same wave on the surface. 5. And consequently, the primæval sea could have carried along with it stones of a huge bulk, loosen'd spontaneously from mountains, and strew the earth up and down with them, and even move its whole bottom. 6. In the same manner as the atmosphere at its bottom usually drives along, barks, leaves, feathers, &c. which are a thousand times lighter, provided the air be agi-

How large stones may be roll'd a great way, accounted for hydrostatically.

agitated by a tempest; and these are carried away and rais'd aloft, as they are lighter: And this force is partly owing to the height of the atmosphere, which being agitated imparts by the weight of its column the same force to a tempest, which another force would to a greater body in motion. 7. We may have many instances of this from those bulwarks or dykes, which are built of a double frame of boards and heaps of stones: so often as the water rises to 3 or 4 yards, which is usual in winter, we see the water have so much force, as often to overturn these dykes, and carry the stones along with it, and convey them sometimes to the distance of 100 yards, which is also owing to the height of the water. 8. Hence in those parts of *Sweden* that are highest, from the sea, as in *Orebro*, which lies between two seas, larger and more numerous broken fragments are observ'd than any where else; because so far the waves could drive and follow, not higher, because nearer to the surface.

From these things we may deduce, that the face of the present earth owes its inequality to the ocean; and all those parts which consist of slime, shells, sand and stones, and which are unequal, to the fluctuation of the sea at the bottom: Whence arise 1. So many kinds and figures of hills; 2. So many *Strata* in these; 3. So many ridges of mountains, consisting partly of sands, partly of smaller and partly of larger stones, and extending for 8 or 10 miles; 4. The roundness of those small stones, of which large ridges of mountains consist: For, they seem as if they were turn'd in a lathe, which is an indication of their agitation and mutual attrition by their continual rolling motion at the bottom. 5. And what very much confirms this opinion is, that the above ridges in *Sweden* do for the most part run north and south; which seems to have arisen from the continual easterly and westerly winds, such as are at this day in the great ocean: For, such must necessarily have been in the diluvian and northern ocean, when it wanted a shore &c.

To what the present face of the earth owes its inequality.

All these things might have happen'd in a deluge; but whether all of them in that of *Noah*, may possibly be question'd; the reason is because in very many places the ribs and other different parts of ships are still found and these rais'd above the surface of the sea at this day to 40 and 50 yards nearly; and even in mountains themselves we find anchors and cables and many other things which indicate, that the ancient inhabitants had a harbour there: And it is certain that the surface of the *Baltic* does still gradually subside towards the north; and in 70 years we find to 4 and 5 yards perpendicular height: Whence in many places they now plow and sow, where 100 years ago they sail'd and catch'd fish. In *Westro-Bothnia*, within the space of one century, some towns are removed, as it were, spontaneously from the shore and are become distant some hundred miles from the ancient harbour: And we are likewise told the same of *Upsal* and other places; which may be indications that all these changes did not happen in the

universal deluge ; but that the northern countries especially, lay long under water after the deluge and gradually appear'd or became habitable, as the sea subsided towards the north. Which if it can be further confirm'd by experiments about *Lubeck*, it will supply a handle of surmising 1. That the horizontal pressure of our part of the earth is subject to change ; which follows, if the seas towards the poles be depress'd and elevated, as is affirm'd towards the equator. 2. And consequently, that the distances in latitude vary. 3. That some continents might formerly have been islands, and in tract of time be joined upon the subsiding of the sea.

A new method of improving barren, stony and sandy Lands. From the Breslaw Collection, July, An. 1717. Class V. Art. 7 p. 106.

Translated from the HIGH-DUTCH.

The improve-
ment of barren
lands by sowing
sainfoin.

FIELDS, entirely barren, mossy, sandy and stony, and that bear neither grass nor any other thing for the use of man or beast, are improv'd by sowing sainfoin in them ; and they not only yield a fine, rich and wholesome food for cattle, but also the ground is improv'd in such manner as to be fit for corn. This method has ever since the year 1676 and 1677 been known especially in *Neufchattel* ; after that a certain nobleman had sown no more than two pounds of sainfoin in a small farm, with which at first, indeed, he could maintain no more than one single head of cattle ; but afterwards by farther culture above twenty, and also make considerable profit of it. From that time this method of improving land was more and more known in the canton of *Switz* ; and us'd with good success and no small advantage on barren lands in *Neufchattel*, *Solothurn*, *Bern*, the *Pais de Vaude* and other places, as also in *Burgundy* and the adjacent countries ; at last also in *Germany*, as in *Austria*, *Suabia*, *Franconia*, *Bavaria*, *Pomerania*, in the *Marckt* and other parts.

The manner of
managing the
sainfoin.

At *Ratisbon* was publish'd a treatise on the subject of this improvement to the following purpose : This seed, mixt with some oats, is sown in the same manner as hemp-seed, especially in the months of *March* and *April*, on fields somewhat sloping, hollow, sandy, nay even stony and cover'd with moss ; but by no means on wet or clayey meadow grounds, gardens, and fields, where no good grass will grow : And upon this a fine and plentiful clover, with a great deal of grass growing among it, springs up ; and from month to month, and year to year, without any farther culture it propagates and increases of itself in such manner, that in 15 or 20 years there is no occasion for breaking up the ground anew or sowing it. The reason of mixing the oats with it is, that the clover-seed may not fall too thick, nor grow up too rank. For the first year you must only cut down the oats, but the following, the clover, and that after the seed is ripe ;
and

and it grows so rank that you may afterwards mow it three or four times a year. It yields the softest grass when cut down in the bloom; but if you would preserve the seed, it is better to wait till it is ripe, when, indeed, the clover is somewhat stronger, but very serviceable for foddering cattle, and then you may thresh out the seed. When the clover will no longer grow upon that field, corn thrives very well in it, as it acquires from the many and long roots of the sainfoin a strong manure. Now this clover affords an excellent food, especially for cows, who thereby yield a great deal of milk. As to horses, if the sainfoin were given them in plenty, and alone without any other fodder, there would be a hazard of their growing too fat by it, and becoming regardless of common hay.

From the above treatise we may see, that this is not bare speculation, but what is actually performed with great advantage in the canton of Switz, and particularly in Bern: And we farther add, that *Joseph von Feldic*, in his *Bohemian* and *Austrian Oeconomist*^a, testifies from his own observation, that he has seen the trial of it both in the *Marckt* and other parts, and found it hold good.

An aerometrical Essay towards the improvement of the Thermometer.

By S. Klingenshierna. From the *Acta Literaria Sueciæ*. Tri-
mestre tertium Anni 1723, p. 436.

Translated from the LATIN.

1. **T**HE given density of the air corresponds to the given gravity of the atmosphere, and to the given degree of heat 2, The ratio of the densities of the air, arising from two given degrees of heat, in any degree of the gravity of the atmosphere is constant. Suppositions deduced from experiments.
3. The density of the air, *cæteris paribus*, is proportional to the gravity of the atmosphere.

I distinguish the changes of heat into degrees, according to the degrees or quantities of the changes, which the heat produces in the density of the air; and consequently one degree of heat will be reckon'd to be to another reciprocally as the density of the air, corresponding to that degree of heat, to the density of the air, corresponding to this degree of heat; so far as the change of these densities does not proceed from the altered gravity of the atmosphere, but only from the decrement, or increment of heat. Definition.

Equal increments are reckon'd to be added to unequal degrees of heat, when the decrements of the densities, or the increments of the volumes of the air are in the direct ratio of the first volumes, and inverse ratio of the first heats. Corollary.

Let

^a p. 154.

Theorem I.

Plate II. Fig. 8.

Let the glass tube AD be open at D, and terminate in a larger ball A, and in any part of this tube let there be a drop of mercury C filling its cavity; I say, that the air, included in this instrument, is of the same density with the ambient air.

Demonstration:

For; the mutations of heat are easily communicated by the instrument to the included air, as appears by experience: Whence the elasticity of the internal air becomes of a sudden to that of the external, as the density of the former to that of the latter: Wherefore, if these densities be suppos'd unequal, the elasticity of the denser will prevail, and by protruding the drop of mercury C, reduce it to equality. Q. E. D.

Corollary 1.

The density of the included air, *cæteris paribus*, is proportional to the gravity of the atmosphere by *Supposition 3*. The volume, therefore, or space which the included air occupies, is reciprocally proportional to the gravity of the atmosphere.

Corollary 2.

The same degree of heat remaining, the drop C is protruded towards A, if the gravity of the atmosphere be increas'd, but towards D, if the same be diminish'd.

Corollary 3.

The gravity of the atmosphere remaining, the drop C is protruded towards A, if the heat be diminish'd, but towards D, if it be increas'd.

Theorem II.
Fig. 9.

Laying down these things; let EG be a barometer, in which the height of the mercury is EF; and if the same degree of heat remaining, the mercury subside successively thro' equal degrees, 1, 2, 3, 4, 5, &c. by the diminish'd gravity of the atmosphere; I say, that the drop of mercury C will at the same time be protruded through the degrees *a, b, c, d, e, &c.* So that the volumes of the included air, or the capacities AC, Aa, Ab, Ac, Ad, &c. be in harmonical progression.

Demonstration:

Seeing the density of the included air in a given degree of heat is proportional to the gravity of the atmosphere (*Cor. 1. Theor. 1.*) and the gravity of the atmosphere is proportional to the height of the mercury in the barometer, the density of the included air will also be proportional to the height of the barometer: Wherefore, seeing the mercury subsiding thro' equal degrees, 1, 2, 3, 4, 5, &c. successively, the heights of the barometer, and consequently the gravities of the atmosphere, corresponding to these heights, are in arithmetical progression; the densities of the included air will in like manner be in arithmetical progression; and therefore its successive volumes, or the spaces AC, Aa, Ab, Ac, Ad, &c. which that included air successively occupies, will be in an inverse arithmetical progression, *i. e.* in an harmonical progression. Q. E. D.

Theorem III.

The quantity or degree of heat is as the weight of the atmosphere, and the volume of the included air conjointly.

Demonstration.

The degree of heat being given, the density of the included air is as the weight of the atmosphere (*Cor. 1. Theor. 1.*) and the weight of the atmosphere being given, the density of the same air is reciprocally as the heat:
by/

by the *definition*: Wherefore, neither being given; the density is directly as the weight of the atmosphere, add inversely as the heat; and therefore the heat directly as the weight of the atmosphere and inversely as the density: But the density of the air is reciprocally proportional to its volume: The heat, therefore, is as the weight of the atmosphere and the volume of the included air conjointly. Q. E. D.

The heat is as the height of the barometer and the volume of the included air conjointly. Corollary.

In our instrument let the drop of mercury stand at any time in C, the height of the mercury in the barometer being EF; let the drop also at another time stand in H, the height of the barometer being E₃; and let the capacity AC to the capacity Ac be taken reciprocally as the height EF to the height E₃; I say that the heat in the first case is to the heat in the second case, as the capacity Ac to the capacity AH. Theorem IV. Fig. 8.

The heat in the first case is to that in the second, as the height of the barometer EF and the capacity AC conjointly to the height of the barometer E₃ and the capacity AH conjointly (*Cor. Theor. III.*) and therefore by division of ratio, as the height EF and the capacity AC directly, and the height E₃ inversely to the capacity AH: But the capacity Ac is likewise as the height EF and the capacity AC directly and the height E₃ inversely (by the *construction*) wherefore the heat in the first case is to that in the second, as the capacity AC to the capacity AH. Q. E. D. Demonstration.

Our instrument AD, therefore, compar'd with the barometer in the manner above describ'd serves to distinguish and measure the degrees and alterations of heat. Corollary.

Equal changes in the degree of heat produce changes in the volume of the included air reciprocally proportional to the height of the barometer. Theorem V.

For, in this case, the increments or decrements of the volumes are in the direct ratio of the first volumes, and in the reciprocal ratio of the first heats (by *Corol. of definition*) but the heat is as the height of the barometer and the volume of included air conjointly (*Cor. Theor. III.*) wherefore, the mutations of the volumes are in the direct ratio of the first volumes and the inverse ratio of the same volumes and of the heights of the barometer, *i. e.* (the direct and inverse ratio's of the volumes destroying each other) in the inverse ratio of the height of the barometer. Q. E. D. Demonstration.

And the height of the barometer being given, equal changes of heat produce equal decrements or increments of the volumes of the included air. Corollary.

If any one would compare this theory with experience, the instrument seems to be very commodiously constructed in the following manner: Having prepar'd the glass-instrument AD, whose tube let be as long as possible, let the capacities of the ball A and of the tube AD and each of its parts be very carefully investigated: Wherefore, it is to be observ'd, that the capacity of the tube ought to be to that of the ball at least as 1 to Scholium 1.

to 6 ; for, the least density of the air, when the least gravity of the atmosphere has the greatest degree of heat, is to its greatest density, produced by the concurrence of the greatest degree of cold with the greatest gravity of the atmosphere, nearly as 6 to 7. In the next place let the position of the drop of mercury be chose about the middle of the tube, as for instance, in C, the mercury in the barometer being in like manner at a mean height in F ; and let the divisions of the scale of the barometer on each side the point F be 1, 2, 3, 4, &c. Then if the tube be divided on each side the point C into the parts Ca, ab, bc, cd, &c. so that the capacities AC, Aa, Ab, Ac, &c. be reciprocally proportional to the heights of the barometer EF, E1, E2, E3, &c. which is done by taking Ca, Cb, Cc, Cd, &c. to AC, Aa, Ab, Ac, &c. respectively, as F1, F2, F3, F4, &c. to E1, E2, E3, E4, &c. respectively, as may be easily demonstrated. In fine, let the tube be divided from its upper part into equal degrees f, g, h, i, k, &c. so that the capacity of a small portion of the tube, corresponding to any degree be to the capacity of the ball A, as 1 to 600 ; and the instrument will be perfect : For, the ratio of one degree of heat to another here is found by *Theor.* IV. and the ratio of the increments by *Theor.* V.

Scholium 2.

The *Florentine* thermometers are reckon'd the best; but it has been long since discover'd, that they have many, and those no small imperfections : For, the spirits of wine by a great degree of cold, contracted into a less space, do too slowly obey the approaching heat: And it is observ'd (a remarkable instance of the imperfection of this instrument) that two thermometers do scarce more than once show together the same points, which, indeed, hinders that the changes of heat in one and the same place, much less in different places, cannot be accurately known : And which is a principal thing, you cannot in any intelligible manner measure the heat and distinguish it into degrees, which notwithstanding is very necessary, if we are to compare together thermometrical observations made in different parts ; and hence deduce the ratio or difference of heats. But I am confident that the instrument just now described, will easily perform all this; providing we had an easy method of properly measuring its capacity, which will probably still remain a difficulty : But as we must know the capacity of the whole instrument, as also the capacities of the ball and tube apart; so it seems expedient in practice, if a narrower tube be taken ; nor indeed is there occasion for its being longer than that by its capacity it equal the sixth part of the ball : And if two such instruments be compar'd together only once, and the points they show at the same time be noted, we shall hence have all the points, which they ought to show at the same time.

*The History of the Invention of the Phosphorus. By G. G. L.
From the Miscellanea Berolinensia. Tom. I. p. 91.*

Translated from the LATIN.

IT importeth the sciences, that the history of memorable inventions be rightly deliver'd. Among the inventions of our age, the *phosphorus igneus* is to be reckon'd none of the least: It differs from other naturally shining bodies in this; namely, that in reality it is nothing other than a kind of conceal'd fire, which discovers itself by its light and smoke, but if you rub it harder, it will break out into a flame. This discovery appear'd about the year 1677, when a little before, *Balduin's phosphorus* gave hopes of it, which is an artificial imitation of the natural *Bolognian stone*; and on which *Fortunius Licetus* formerly wrote a treatise, entitled *Lithosphorus*; and not long ago Count *Marfili* of *Bologna* publish'd experiments and observations on it: And at *Berlin* Dr. *Christian Menzelius* in a particular treatise compar'd the natural and artificial *phosphorus*. *Christopher Adolphus Balduin*, governor or bailiff of a certain place in *Misnia*, happen'd to dissolve chalk in *aqua fortis*, or spirit of nitre, which last he again brought over by the fire; and he found the remaining body to imbibe the light, when expos'd thereto, and retain it for some time, and carry it along with it into a dark place, as a sponge does the water it has imbib'd. This experiment did not a little startle the *Cartesians* (very few of whom had seen the *Bolognian stone*) that light should of a sudden become a gross and portable thing, whose rays they suppos'd to consist in preffion only, and to be propagated in an instant of time. *Balduin* concealely describ'd his experiment in a treatise, entitled *Aurum Auræ*.

The *phosphorus* what, and the time of its discovery.

Next follow'd *Brand's phosphorus*, namely that which I call the *igneus*, as also the *pyropus*, and which afterwards had the name of *phosphorus* by way of eminence; of whose inventor there appear'd in 1692 an account in *French* by an excellent person, conversant in the experiments on this *phosphorus*; but in several places, and those of considerable moment, he departs from matter of fact; and, in my opinion, his account is taken either from the relations of people too partial, or even from uncertain reports. Upon perusing it, I sent my animadversions to my friend, and advis'd him to correct what was amiss, but all to no purpose; either because his prejudice was too great, or because it seem'd to be a matter that must be further enquired into: And therefore, lest the truth of the matter of fact, at this day probably known but to a few, should be lost, I have now resolv'd to publish these remarks, after first having given the above relation itself, that its difference from the matter of fact, and the necessity of my animadversions may the better appear.

Brand's phosphorus.

Account thereof
by a French Au-
thor.

That account, therefore, which was publish'd in 1692, is to the following purpose. ' The first invention of this *phosphorus* is owing to chance, as many other excellent inventions are. A certain *German* chemist, call'd *Brand*, living at *Hamburg*, a man obscure, and of mean parentage, morose and phantastical in his humour, and who affected to be mysterious in all his actions, found out this luminous matter, while he was in quest of something else. He had from his youth applied himself to the art of glass-making; but he threw this up, that he might have more leisure to apply himself to the *philosopher's stone*, with the hopes of which his head was fill'd: Persuading himself, therefore, that the secret of the stone consists in a preparation of urine, he for a long time, and in different manners, labour'd on it in vain. At length in the year 1669, after a strong distillation of urine, he found in the receiver a lucid matter, which afterwards got the name of *phosphorus*. This he show'd to some friends, and among others to *Kunkel*, chemist to the Elector of *Saxony*; but he took care not to say any thing, by which the composition might be discover'd; and he died without communicating his secret to any one. After his death, *Kunkel*, not bearing that so excellent a secret should be lost, attempted the revival of the invention; and reflecting that *Brand* had all his life long labour'd on urine, suspected that in it he was to look for the *phosphorus*: He, therefore, applied himself to it; and after an obstinate labour of four years, he at length hit on it. He did not affect to be so mysterious as *Brand*, but communicated the secret to some persons about the year 1679. In *France* and *England* Dr. *Kraft* of *Dresden* is reckon'd the inventor of this *phosphorus*; because he first brought it to these parts: But in reality he was only the dispenser of it, having receiv'd it from *Kunkel* to show it to learned foreigners; nay, *Kraft* at that time when he went about, did not know the composition'.

Animal versions
on the above
account.

This is the account. But I wonder that *Brand*, a man but little known, is us'd in it with so much contempt, and that from uncertain relations; seeing we are oblig'd to him for a very excellent discovery: But it is more to be wonder'd at, that he is said to be dead at the time that *Kraft* and *Kunkel* communicated the *phosphorus* to the world, both in writing, and by word of mouth; and that *Kunkel* reviv'd the art, which died with the inventor: Since it is very certain, that *Kunkel* went to *Brand* and obtain'd the secret of him; and that *Brand* long surviv'd this, and complain'd of *Kunkel*; nay, as far as I have learned, he was still living in the year 1692, at the time the above account came out: And so far was the good-natur'd *Brand* from being difficult, morose and mysterious in communicating his secret, that he suffer'd himself to be prevail'd upon by some small presents, and the hopes of greater rewards, to disclose it to *Kraft* and *Kunkel*. Whether he was of so very obscure and low parentage, as to deserve to be contemptuously so call'd, I cannot affirm; but this I know that *Kunkel* in his

his youth applied himself to the art of glass-making; on which subject he has publish'd a useful treatise in *High Dutch*; and probably, his father might have been a glass-maker. I am, therefore, apt to think that the above relation has shifted the persons. *Brand*, as far as I have learned, was, when a young man, in the army; and was distinguish'd in it by some superior rank: He also married a woman with some money; but it was said, he spent his patrimony in alchemy; nor did he so much apply himself to the *philosopher's stone*, as to particular processes; and he likewise dispos'd of chemical preparations for medicinal uses.

The invention of the *phosphorus* happen'd thus; *Brand* had fallen on a certain chemical process, extant in a printed book, which taught how to prepare from urine a liquor fit to ripen a particle of silver into gold; And in labouring on this he found out his *phosphorus*. He had some acquaintance with *Jo. Daniel Kraft*, then of the council of commerce to the Elector of *Saxony*; and by his means with *Jo. Kunkel*, one of the said Prince's bed-chamber; but who under that character perform'd chemical processes. On persuading *Brand* that this *arcanum* might be sold to the Great at a high price; and offering him their assistance, they obtain'd the composition from him. And upon going from *Dresden* to *Hamburg*, they both saw and learn'd from him the process of the *phosphorus*: But *Kunkel*, upon his return home, had committed some mistake in the process, and for a long time could not hit upon the *phosphorus*; and he sent a letter of complaint to *Brand*, which I have seen, and in which he bewails that the secret was not communicated to him sincerely enough; but *Brand* repenting that he had been so easy in the communication, delay'd the setting him to rights. *Kunkel*, in the mean time, after various trials, corrected the error of himself; whence he pretended to be the inventor; of this *Brand* bitterly complain'd.

The manner of the discovery of the *phosphorus* by *Brand*.

Kunkel was chemist to *Job. George III.* Elector of *Saxony*; and as formerly the Elector *Augustus* was certainly thought in those parts to be possess'd of some profitable alchemical *arcana's*; the writings (partly in this Prince's own hand) which are extant at *Dresden*, and are thought to contain something of the secret, were entrusted to *Kunkel*, to try if he could discover any thing from them: And some of these came also into my hands. *Kunkel* had a laboratory given him at *Anneberg*, but nothing worthy of expectation was discover'd. After this when *Cassius*, a physician of *Hamburg* (whose treatise on gold is extant) had discover'd the artificial ruby by help of gold and tin, which was a long time one of the *desiderata*; *Kunkel*, conversant in glass-making, and the art of finelting, did not a little improve the method, and he taught how to make pretty large vessels of it; and by that means he obtain'd the favour of *Frederick William, the Great*, Elector of *Brandenburg*, who was curious in such matters; and he went into his service on no contemptible terms, and not long ago he died at *Berlin*.

An account of *Kunkel*.

Kraft's character.

Jo. Daniel Kraft of *Miltenberg* had in his youth applied himself to physick, and having got the degree of doctor, he was physician to the miners at *Cellerfeld* in *Hartz*: After this he went to *Holland*, *England* and *North-America*, and acquir'd a considerable skill in those things, which relate not only to the knowledge of nature and to chemistry, but likewise to works of art, handicrafts and commerce; He was, therefore, very acceptable to princes, fond of curiosities, and bent on the improving and enlarging the skill of handicrafts and commerce; and especially to *Job. Philip*, Elector of *Mentz*, and to the Electors of *Saxony* and *Brandenburg*; and under the Elector of *Mentz* and *Saxony* he was of the council of commerce: He was a man of erudition and eloquence, whether he was to write or speak: His only defect was, that at times he was diverted from more certain and useful pursuits by some inbred turn, or rather disease, to alchemical conceits.

Becher's character.

Job. Joach. Becher of *Spire*, physician to the Elector of *Mentz*, and afterwards of the council of commerce at *Munich* and *Vienna*, was a man of ingenuity, and skill'd in the *German* writings, but he indulged too much his pruriency of scribbling, and huddled together certainties and uncertainties, as for the most part he took what he wrote from the relations of others; this man, I say, profited very much by the conversation and labours of *Kraft*: He was one that could little bear the fatigue of chemical processes, as his friends found by his laboratory at *Munich*, which he mentions in the title to his *physica subterranea*: As at length he lost all favour at Court, and as the great promises made him came to nothing, he propos'd to the *Dutch* gold ore from those hills of sand, which they call *Dunas*: He afterwards died at the tin-mines in *Cornwall*, being brought very low by his extravagance: A man who deserv'd a better fate, and which he might have had, had he been without that malignant humour of banter, by which he alienated both his friends and patrons; and in his good fortune, had he been without that pride, profusion and vanity, and without that licentiousness of fiction, of which he himself boasted among his acquaintance, either when he would gain credit to his words, or slander others. Various judgments, and those in extremes, have been pass'd upon him by those, who only knew him by his writings; seeing some, upon observing every where the rashness of the author, despise all he has writ; whereas others again esteem him as a great philosopher, and almost as an adept. *Kraft*, moreover, who was an honest man, being by my means on the point of entering into the Elector of *Brunswick's* service, died a few years ago in *Holland*. I thought it proper on this occasion to observe these things of men, who excell'd in genius and the knowledge of nature; and with whom I myself had a more intimate acquaintance; and who, if they had had proper encouragement, and a steadiness of temper, equal to the vigour of their genius, and a greater desire for truth than an ambition of raising themselves by ambiguous

guous arts, would have acquitted themselves, so as to deserve to be reckon'd the ornaments both of their time and country.

But to return to *Brand's phosphorus*: *Kraft* undertook to vend the discovery among the Great; and in his way to *England* he made me a visit at *Hanover*, and ingenuously mention'd to me both the matter of the process and the author *Brand*; and he likewise shew'd the experiment of the *phosphorus* to the great surprize of Duke *John Frederic*; and afterwards in *England* to King *Charles II.* Prince *Rupert*, the illustrious Mr. *Boyle* and others, of which there is an account by Dr. *Hook*. But he never, as far as I know, mention'd himself as the inventor; neither did he, as the above relation seems to hint, carry the *phosphorus* into *France*; seeing it was first sent thither by me to *Huygens*; and at length the composition itself was by the illustrious *Tschirnhausen*, upon his first return from *Germany* into *France*, communicated from me to the *Royal Academy*, to whom *Huygens* had already shewn the thing: That *Boyle* had got but an imperfect description of it appears from his dissertation on the *phosphorus*; for, his *phosphorus* differs from *Brand's* only in this, that it is more imperfect.

Brand's phosphorus communicates the process to the world by Kraft.

But Duke *John Frederic*, as he was a magnificent and generous prince, order'd that I should send for the inventor: *Brand* therefore came to *Hanover*, and faithfully communicated to us the process; for, whatever he did, I imitated in another laboratory. Upon collecting a large quantity of urine, *Brand* came to us, and without the city he went thro' the process. Upon *Brand's* return to *Hamburg*, the duke settled an annual pension upon him, which was punctually paid him till the duke's death: And this, probably, was the only encouragement of moment he reap'd from his *phosphorus*.

Brand communicates the process to Duke John of Hanover.

I myself shew'd to the same prince, who was very curious in these matters, another kind of *phosphorus*, which we may call the *thermophosphorus*, which does not acquire its shining quality from light, as the *Bolognian* and *Balduin's phosphorus*, but from heat. There is a kind of *fluor* in mines, with the powder of which if you draw letters and figures on an iron-plate and lay the plate upon burning coals, the strokes shine, tho' the plate be in no wise ignited, nor tho' the light with its rays cannot penetrate from the coals to the figures.

Another kind of phosphorus.

It is a thing commonly known, that hard bodies acquire heat, and at last take fire by motion; and the flame, produced by the attrition of two pieces of wood, was by the ancient *Saxons* regarded as a religious ceremony, which they call'd *nod-fyr*, that is, *fire produc'd, in defect of fuel, in a case of necessity*, as appears from *Charlemagn's Capitular*, in which that superstition together with others is prohibited; and very lately, traces of this superstition were found remaining among the Boors of *Brunswick*; and in some parts they were wont, on the first day of the year, to put out the fires in a whole village, and to carry that produc'd by the attrition of two pieces

Heat and fire produc'd by attrition.

of

of wood to all the houses; and some of them purified their cattle at a pile of wood, kindled from that fire, as a charm against diseases: But we are not so well acquainted with the manner, in which smiths at our mines kindle the fire extinguish'd in their forges: They strike with a hammer an iron bar on its very edge, and which is wont to come from the mines in form of a quadrangular prism: This bar they shift that the edge may be alternately struck, now on the right, and again on the left; and thus it immediately becomes hot, and after repeated blows glowing hot, so as to set on fire any inflammable matter.

*Job. Bernoulli's
phosphorus.*

We have, besides, other kinds of *phosphori*, in which there are no traces of fire; among which the principal is that, which we owe to *Job. Bernouilli*, who has improv'd the observations of others on mercury shining *in vacuo*, and carried it so far, that now it may be produced at pleasure; whereas before, mercury was rarely and by chance made to shine. It is credible, that this *phosphorus* always retains its shining quality, or at the least, for a long time; because it does not stand in need of the free air to make it shine, as the *phosphorus igneus* does, but emits a light by 'only shaking it in a glass, hermetically seal'd; and with this the King of *Prussia* was so well pleas'd, that he rewarded the inventor with a gold medallion: And I understand, that M. *Dutal* at *Paris* and others, have labour'd with remarkable success in establishing and promoting this *phosphorus*. It would be worthy enquiry, what quantity of light might be produc'd by many such *phosphori*, continually shook; for, a continu'd shaking may be easily effected by means of a machine, and the light of many *phosphori* may be collected either by refraction or reflexion; a thing, I wonder, has not been hitherto attempted.

Of the Ball of Fire which was seen in Silesia, Lausnitz, Poland, Prussia, and Hungary, on August 10, 1717; together with historical Reflections thereon. From the Breslaw Collection, August 1717, Class IV. Art. II. p. 157.

Translated from the HIGH-DUTCH.

*An account of
the fire-ball, as it
appear'd at Bre-
slaw.*

ON August 10, about half 9 in the evening, in a clear sky, towards the east, there was plainly 'seen by every body at *Breslaw*, as also in other parts, what is call'd a *fire-ball*, which like a mass of fire suddenly and swiftly fell down to the earth; and indeed, so far as one could judge by the swiftness, there appear'd a sudden brightness aloft in the air, during which short flash, the inflam'd matter, as it were, came together, and in form of a ball came down towards the east, suddenly and nearly in a direct line; at the least but a little inclin'd; but in its fall it also seem'd to spring

spring into pieces, and in its burning and motion it continu'd no longer than about 15 or 20 seconds; yet so, that as this falling *fire-ball* trail'd along a bright tail, after the extinction of the mass of fire, this tail was still observ'd for some time in form of a whitish and bright streak: By it the atmosphere was now enlighten'd in such a sudden and strong manner, that several persons were apprehensive of an approaching burning, and in this concern they ran to the windows to observe the quarter, where this swift and near fire was: This fire was also so penetrating and sensible, that it was thought to exceed lightning itself: Whence it was observ'd by all and in all places to be so near, that many people imagin'd it fell down over their heads, or before their feet; so that many also affirm'd they had seen it spring into pieces before their eyes on the earth, which was far from being true; in the same manner as people in other parts would have it thought, that it emitted different rays from it like a shooting star; yea many, and those both persons of rank and learning would persuade us, that they perceiv'd a manifest sulphureous smell: No noise was observ'd in its falling down, especially on the account that the *phenomenon* happen'd in a clear sky. The sky mov'd from north north-west; the weather was cool and without any wind stirring; the sky remain'd also clear in the night and pretty fresh; and many unusual shooting stars were observ'd by us and other people in *Breslaw*, who were otherwise wont to observe the heavens in the night-time; and this was the nature of the *phenomenon* at *Breslaw*: The heedless and superstitious populace with apprehensions fram'd to themselves many chimera's about it; sometimes that they had seen a sword, then a broom, and again, some other groundless appearance, such as people in sickness or a raging fever fancy to themselves; among others, a young and sound woman near *Wartenberg*, who, on the appearance of this meteor was in the open field, was so frighten'd by it, that all her limbs began to shrink, and no remedy could be of any service.

We have had accounts of this meteor from several places in *Silesia* and other parts; yet all agree, that in general it was observ'd in the same manner. According to the accounts from *Schweidnitz*, *Glogaw*, *Jauer*, *Lignitz*, *Wolaw*, *Oels*, *Brieg*, *Grotgau*, *Teschchen*, *Trachenberg*, *Wartenberg*, *Militzsch*; and in a word, all over *Silesia*, as also in *Lausnitz*; and besides, in *Poland*, especially in *Masovia*, in *Cracow*, in *Reussen*, in *Calisch* and *Posna*; and farther, in *Prussia*, *Courland*, *Samogitia*, and in other parts; and in fine, also in *Upper Hungary*, as at *Käsemarck*, *Epperies*, and in many other places; but not at *Leipzig*, as we were expressly inform'd. 1. It happen'd at the same time and hour of the day; to wit, *August* 10, between 8 and 9 o'clock. 2. In the same form, like a ball or mass of fire, with a long bright streak trailing after it. 3. And chiefly, according to outward appearance, like a swift mounting fire. 4. Its motion alike, to wit, obliquely from on high, yet with this difference, that in *Silesia* it appear'd to fall almost towards *Hungary*,

Its appearance in different parts.

gary, but in *Hungary* towards *Silesia*, that is, towards the east in *Silesia*, and towards the north north-west in *Hungary*. 5. It was of equal duration, it continuing no where above half a minute in its burning form.

At *Epperies*.

To this we think proper to subjoin the different accounts sent us by learned men; and that we had from a learned physician at *Epperies* is to the following purpose: After a tract of close weather for some days before, yet intermixt with rains at times; at last, on *August* 10, about 9 o'clock in the evening, in a warm and clear sky, in the north was of a sudden observ'd to arise such a bright shining fire, that many people at first thought there had been a sudden burning; the superstitious populace, indeed, form'd to themselves surprising figures; seeing, some of them fancied, that the whole heavens were open'd, others imagin'd a fiery sword, rods, and other absurd conceits: On the contrary, by means of a true and exact observation made here and in other parts (as this meteor was seen in this kingdom for 10 *Hungarian* miles from this place) it presented itself at first in form of an upright burning pillar; as it stood a short time in this manner, it bent itself at first different ways, and soon after sprung into many fiery sparks, in which form it also fell down and vanish'd speedily. Many people had different notions of this *phenomenon*; but for my own part I took it for a pure natural effect; as I was aware, that the inflammable matter collected on the preceeding very close days (by means of which one may be apprehensive of a dreadful storm to ensue) might coalesce in such a form, that after it is set on fire, it might represent what is call'd a *trabs* or *beam*, especially in a calm hot air, as was the case all that day; and also as neither then nor the foregoing days, this matter was not consum'd by any storm of lightning.

At *Kâfemarck* in
Hungary.

The observation from *Kâfemarck* in *Hungary* is as follows; this *phenomenon* appear'd *August* 10, about 9 o'clock in the evening; and all at once, like a bright fire, which illuminated the whole city; and the people observing it, imagin'd that there was fire in all the streets. As I myself was not appriz'd of such a *phenomenon*, and as I saw the clear light, I imagin'd the whole city to be on fire; but as I look'd about me, I only observ'd an arch in the heavens, which indeed at first was in a streight line, but afterwards swerv'd from it, and form'd different large windings; nay, even at last it was observ'd, that the continuity of this arch was broken, and it seem'd as if it consisted of stars standing close by each other, till at last it entirely disappear'd: The light, that was observ'd, resembled lightning, only that it lasted longer, but it afterwards changed into a bright arch, which with its extremities rested on the horizon towards north north-west and south south-east; and thus it stood for upwards of an hour: But at the extremity towards the south south-east it diminish'd, till at last it gradually vanish'd; but under what form this *phenomenon* appear'd and from what quarter it came, I cannot tell, seeing I was not appriz'd of any such appearance.

From

From *Brieg*, not far from *Olau*, we had the following account; this fiery meteor of *Aug. 10*, was not only observ'd here and in the neighbourhood, but also at *Olau* and beyond *Strelen*, and that at the same time. I saw but little of it, only that it pass'd by the windows like a flash of lightning; upon which I went directly to the top of the house, supposing it to be a *draco volans*, as some people also who stood in the court imagin'd it to be; but in the morning as I understood, that it was observ'd at *Wansen* and other parts, I ask'd further what its proper form was; and most of the descriptions agreed, that it fell from the heavens like a four square vessel, with a long tail behind. Now as it was seen in so wide a distance, and that at the same moment of time, I reckon it must have been very high, and possess'd a very large space, as an ordinary storm is wont to do: Whence I take it to be a *chasma*. From the relations I conclude, that the beginning of it was south-west, but its end north-east.

From *Oels*, not far from *Julius-burg*, the account is as follows; the meteor of *August 10*. was also observ'd here every where with surprise; it arose in the evening about 8 o'clock, came from the west to the east and lasted for half a minute, and was like a dreadful storm of lightning; it left behind a stench of burning and sulphur; the common people took it for a *dragon*, and said they had seen him several times fly thus; some describ'd it as a ball or mass of fire; others of an oblong figure, about two foot in length, with a tail, as it were. This burning in the air was observ'd far and near, even as far as *Poland*: Many thought it portended moist and rainy weather, which also ensu'd. A servant of mine, who was obliged to watch a field of wheat saw about midnight with surprise the heavens open and fiery.

From *Mittelwalda* in *Medzibor* we had the following account; the ball of fire on *August 10*. fell from the sky half an hour before 9 in the evening; and was not only observ'd here but also in other places, and with an extraordinary brightness, appearing as if every thing was full of fire, and most people were greatly frighten'd: This fire, as it fell down towards the east, left behind it a shining track like a semicircle; and shone for half a quarter of an hour, and was distinguishable; others would contradict this, and affirm that it fell from the east to the west; others, as they thought, saw it fall in different places, but the remaining shining track plainly show'd in what manner it shot down towards the east; and such parallax is a sign that it must have been set on fire high in the air.

And in this manner were the observations sent us from several places, but which we do not think proper to relate, since all of them agree together; only from *Brandenburg Prussia* we are inform'd, that this meteor was observ'd at the very same time there and in the neighbouring country. The same likewise happen'd in *Lithuania* and other provinces of *Poland*, where this meteor was taken for a sign of some future calamity and partly for a comet, neither of which can be evinced.

Historical Re-
fections on this
Meteor.

In order still more and more to promote the rational knowledge of nature, which is the principal view of our *Collection*, we have thought proper to add the following historical reflections; and 1. That this meteor was observ'd the whole length of *Silesia* eastwards, in *Prussia* and the neighbouring countries, in *Great* and *Little Poland*; and as far as *Theys* in *Hungary*, that is, from about 48 to 52 degrees of latitude; and from 34 to 45 degrees of longitude (according to *Homman's* maps), especially in the north-west parts. 2. That its vertical place appears to have been between *Hungary*, *Poland* and *Silesia*, since with us it was observ'd towards the north-east or north-north-east: Whereas in *Hungary* towards north-west or north north-west; and possibly for its horizon it might have had the *Carpathian* mountains, in which opinion we were afterwards confirmed by a learned friend at *Epperies*, who in general was of the same opinion, only that the particular place cannot hitherto be so exactly determin'd: at the least this is certain, that such *phenomena* are most commonly observ'd to appear as well at sea as in mountains. 3. That, doubtless, in these parts of *Hungary* some days before, the calm, close and clear weather might partly have supplied the matter to this meteor, and partly on account of its expansive and rarefying power have promoted its ascent. 4. That it must have stood very high, and much higher than an ordinary storm; seeing, according to the above accounts, it was observ'd in its north-west length to be about 80 miles distance in latitude and 170 in longitude. 5. That this inflammable matter must have been very subtle, seeing it mounted so high, and also emitted so penetrating and clear a light; and the rarity of the air, as being without thick clouds, promoted the elevation of this matter. 6. That undoubtedly it could produce no real lightning and thunder, as it stood so high and without any clouds. 7. Yet that it must have been accompanied with a great deal of gross matter not so apt to take fire, among other things may be concluded from its long remaining track or tail. 8. That this inflammable substance was no other than the matter of lightning, only distinct from it, as there happen to be clouds or no. 9. That all these fiery aerial meteors, as the *trabs*, *columna*, *draco volans*, *chasma*, *stellæ cadentes*, &c. have in general the same matter, only that they vary, according to the mixture of a more or less gross matter, according to their *matrix* and receptacles, their elevation, the point of the wind or air, the motion of the inflamed matter, according to the diversity of the matter, and according to its simultaneous or successive accension; nay even according to the situation of the eye; and in fine, according to the greater or less degree of judgment in the spectator, by which two last conditions these prodigies of *swords*, *rods*, *armies*, *artillery*, *letters*, &c. are in general observ'd to owe their being. 10. That from such meteors as these, that have their manifest natural causes, and an entirely harmless, yea, in general, a very common existence, nothing

nothing ominous can be concluded, unless by thoughtless and superstitious minds; as 11. Parallel examples show, that such meteors commonly appear in the evening, in northern countries, in hot weather and a clear sky; for the most part in and towards the harvest, in winter and spring. 12. Wherefore we have thought it proper, in order to throw greater light on the subject of this meteor, to alledge some parallel examples.

April 8, 1684, before 11 in the evening, in *Swönitz* in *Saxony* a fire-ball ^{Some parallel instances.} was observ'd to fall from heaven, with a great noise as if it thunder'd. December, 1682, at *Rochlitz* and *Anneberg*, a sulphurous fire-ball was seen to fall slowly in the form of an arch, from the air upon the horizon, from which afterwards flames in the form of snakes mounted up aloft, and run off spiring. August 15, 1683, between *Marienberg* and *Ruckerwald* in *Saxony*, a large fire-ball fell down in the evening from the air, which sprung into pieces, so that its shining lustre was observ'd in *Anneberg*; and at that time there was also an account from *Leipzig*, that on August 12, four minutes before 9 o'clock in the evening, a very bright light arose high in the air, brighter than moon-shine, so that all the streets were illuminated by it; its altitude was from 35 to 40 degrees, somewhat under the arm-pit of *Bootes* towards the *Great Bear*; where at first a small star stood, which soon became as large as *Arcturus*, which stood to the left; and increasing suddenly it became as large as the moon, yet much brighter and whiter; and speedily in form of a mass of fire fell directly downwards, and left a white streak behind it like a rocket: This light was observ'd at *Coburg*, *Bautzen*, *Dresden*, *Gera*, *Schlätz*, *Altenburg*, *Naumburg*, *Eisleben*, as also in other parts of this tract. March 18, 1684, there was again, about 4 o'clock, a fiery-ball observ'd in the air over *Anneberg*. November 13, 1684, about 4 o'clock in the evening, there fell from the heavens, between *Joachims-Thal* and *Gottes-Gabe*, a fiery-ball as large as an ordinary dish; so that it trail'd after it a sharp-pointed flaming track, nine ells long, as far as could be judged by the eye, which at length divided into two and disappear'd^a. In our days, October 7, 1709, at *Durham* in *England*, between 7 and 8 in the evening, at north-west, an uncommon brightness arose, as tho' it had been day; this brightness divided itself into many rays, above which stood the stars, but under it a pitchy dark cloud, which at last broke out into thunder and lightning along with a thick fog. And even this very year towards the close of October, in *Holstein*, in a clear sky to the north, two stars (as they are call'd) were seen standing close by each other, which soon united, but afterwards shot strongly to the south, and emitted a bright streak; and afterwards dissipated into a great number of smaller stars. On December 8th, the same year, was observ'd at *Marienburg* in *Prussia*, soon after midnight, towards the south, a small star, which

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at

^a Vide Lehmanns vom Meissnischen ober-ertzt. Geburge, sect. 6. c. 19. p. 386. seq.

at first shone very bright, but soon after became of a dark red: After this the heavens open'd, in the form of the large wings of a gate, on which there broke out so great a brightness as to be intolerable: At length from the said star, which stood to the left of the gate; there shot out forwards a long bright streak, of a hand-breadth; and after this the gate suddenly shut; and thus this phenomenon, after continuing for better than a minute, disappear'd, being cover'd with clouds. *February 26, 1711*, there was an account from *Strasburg*, that for a little time in the night a dreadful fire, in form of a pillar, was seen over *Brisack* upwards of 2 hours; upon which it fell down with a terrible crash; and like a waving streak took its course southwards towards the Canton of *Switz*. *Oct. 4, 1714*, in the Canton of *Bern*, about 11 in the evening, a great thunder-storm burst out from a thick cloud; but as the clouds were driven by the fire, a *fiery-ball* fell into the *Aar*: Upon which, in a clear sky, was seen a beautiful star of an uncommon bigness; yet without a tail. *October, 1715*, at *Ancona*, towards 5 in the evening, a great fire was seen in the air, which changed into a *fire-ball*, which emitted several fiery flames like darts, which disappear'd in a short time and brought on a great rain. The remarkable meteors seen in the evening of *March 6*, in *England*, &c. and particularly on *March 17*, at *Moscow*, in *Poland*, *Prussia*, *Germany*, *Holland*, &c. are fully treated of by *Halley*, *Balthasar Menzern*, *Paul Patern* at *Dantzick*, but especially by *Wolffius* at *Hall*. We shall only add, that in the present month at *Medzibor* on the first instant, towards evening, a *fiery mass* was seen to fall, call'd a *draco volans*: In which manner we also at *Breslaw* on *August 8*. at 9 o'clock in the evening, in a storm of thunder, observ'd a penetrating lightning, without thunder, from a like inflamed mass of fire, which, probably, as it stood lower or freer than the other storm-clouds, went off without any noise.

An essay towards an account of the Aurora borealis. By Fr. Chr. Maier. From the Com. Acad. Scient. Imp. Petropol. Tom. I. An. 1726, p. 351.

Translated from the LATIN.

The design of
the author.

I. **A**S the appearance of this *light* is so frequent in our northern parts, that the vulgar are no longer surpris'd at it, it was easy for me in a short time to collect a great number of observations: These I now communicate in the present essay, together with my reflections on the origin of the *northern light*, which, as being new, I have resolv'd to submit to the public judgment of the intelligent, that so I may learn by others what consequence they may be of.

2. I propose so to handle the matter, as first to give a succinct account of all the *phenomena*, collected from the observations I have already made: In the next place to deduce some conclusions from these, by means of which and of subsidiary propositions, fetch'd from natural philosophy, I may attempt to enter into the nature of this *light*. Further open'd.

3. On account of the twofold appearance of the *lumen boreale* we may make two species of it; the first is common and more frequent in these parts, it possesses the north under the form of an arch, emits rays or lucid rods to the *vertex*, and shines with a calm light; the other which is less frequent occupies the heavens towards all points, is divided into parts, to which very short, or for the most part, no rods at all adhere: Its light is generally thought to be undulating or tremulous: From what is to be said farther on, it will be manifest that these two species do not in reality differ, and that this twofold appearance is produced by the situation alone. Two species of a *lumen boreale*.

4. The *phenomena* of the first species are as follows; 1. The lucid arch is dispos'd in such sort towards the north, that its concave side regards the horizon, and its convex the vertex. 2. The highest part of the arch does always to sense exactly occupy the north. 3. Its legs generally touch the horizon, 4. The higher the arch is, the more its legs are spread out. 5. I never observ'd the height of the arch to exceed 40 degrees, nor the amplitude of its legs, a semicircle. 6. The more depress'd the arch is, the neater and more regular is its roundness; and for the most part the higher it is, the more it is wont to be deform'd by interposing fissures, hiatus's, protuberances, flexures, &c. and sometimes without any change of its altitude, an irregular arch falls sensibly into order and *vice versa*. 7. It often happens that new arches are produced, which are usually either higher or lower than the former; yet they always coalesce with it, by which very thing it happens, that it seems to become either lower or higher. 8. Yet sometimes it becomes higher and lower without the observable accession of new arches. 9. The space between the arch and the horizon is always dark; yet it very clearly transmits the rays of the stars, unless that space be fill'd with dark clouds. 10. The interior rim of the arch is for the most part obscure, the exterior lucid: But we cannot distinguish the confines of light and darkness; because they gradually run into each other. 11. Rods, or sometimes broader lucid tracts, extending in length, insist on the exterior edge of the arch, and shine somewhat weaker than the arch itself: But it very often happens, that that part of the arch, from which the rods issue, shines more than the other parts. 12. All of them tend in a right line to the *vertex*, which they sometimes reach, nay sometimes seem to go beyond it. 13. Each rod is almost of the same breadth both in its beginning and end. 14. Each rod has almost an equable brightness, only that near the arch it is sometimes observ'd brighter than near the *vertex*. 15. The duration of one rod is short and uncertain; it

it is usually about 10 seconds. 16. Their rise and disappearing is generally sudden; yet they sometimes appear sooner at the arch than in the *vertex*; and sometimes this order is inverted: And thus likewise they suddenly disappear in this or that order. 17. Sometimes, but rarely, the rods are not entire; and they seem to be cut, as it were, into pieces. 18. They generally move either towards the east or towards the west; sometimes slower and again swifter, sometimes one is swifter than another; so that they overtake or outrun each other: But in the mean time neither is the straightness nor the direction of the rods to the *vertex* changed. 19. They are sometimes either few in number, or none at all, tho' the arch be very bright; and sometimes they are so numerous, that the arch appears like a comb. 20. It often happens that several appear at the same time, and again disappear at the same time. 21. The stars every where shine thro' them, except thro' the obscure interior edge of the arch, which, if there be any, covers the stars. 22. It often happens that some clouds appear, which are higher than those the *lumen boreale* has left under it; which, indeed, is manifest from the different colours and motions: For, it is impossible that clouds, seen in the same part of the heavens, should diversely move and be illuminated, unless on account of their height from the earth they differ much.

The phenomena
of the second
species.

5. The *phenomena* of the second species are the following; 1. At first sight the heavens seem to be on flames; the light appears tremulous and flashing, almost in the same manner as in a heap of burning hot coals: But this coruscation is sometimes more, sometimes less, and sometimes scarce sensible at all. 2. Upon a closer attention we may observe little lucid clouds, or *nubeculae* sprinkled up and down; sometimes this observation is easy; sometimes difficult, either as the *nubeculae* are dense or rare, and as they burn slower or swifter. 3. When I have sometimes observ'd such a *nubecula* in the *vertex* itself, and it was now kindled, and now again extinguish'd, I observ'd it afterwards to become more obscure, and gradually leave a black cloud beneath it, with which at length it was cover'd. 4. I afterwards observ'd the same thing in other *nubeculae*, but I found that in the mean time, while they are kindled and extinguished, they change their place and figure but little or nothing. 5. While they are kindled, they are wont to continue as long as the rods of the first species last^a. 6. The *nubeculae*, which are at a distance from the *vertex*, do sometimes project lucid rods, but these short and slender; and they are the shorter, the nearer they are to the *vertex*. 7. I have it from the relation of others, that sometimes blue lightnings are interspers'd with such rods. 8. I rarely observ'd this species of the *lumen boreale* alone; it was for the most part accompanied with the first species above mentioned; and the one either preceeds or follows the other. 9. The light of these

^a § 4. *supra* N. 15.

these *nubeculae* is never so great as that of the arch usually is ^b. 10. This light towards the horizon is often times more saturated than in the vertex; so that sometimes the horizon all over shines, almost in the same manner as the northern arch itself ^c.

6. The *phenomena* common to both species are the following; 1. Both species are wont to make their appearance from the autumnal to the vernal equinox: For, in summer I never observ'd them. 2. For the most part clouds, dispos'd at first like so many scales, are wont to succeed the *light*, afterwards they are augmented, and gradually accumulated. 3. Both species for the most part chuse to appear in a serene, or half serene sky; yet I sometimes observ'd them thro' dense clouds, covering the heavens every where, and here and there opening. 4. The brightness of both *lights* is pale or whitish. 5. Both *lights* are sometimes carried by a small breath of wind towards any quarter of the heavens; but which is always contrary to the point towards which the wind in the inferior region of the air blows. I have hitherto found no instance that contradicts this *phenomenon*. 6. I have often observ'd that warm weather usually preceeds or accompanies it; and that cold weather follows it. 7. If it happen to appear for some nights successively, which is often the case, upon that the following *lights* become weaker, so as at length to be scarce visible. 8. The duration of both lights is very variable; it is sometimes for whole nights, and sometimes for a few hours, as the air is either calm or agitated.

Phenomena common to both species.

7. From the consideration of the above *phenomena* I conclude, that these two species only differ in appearance: For, most of their properties are common ^d; and such as are thought to be peculiar to each of them, I shall hereafter explain from the diversity of the situation alone, and this very diversity is taken notice of §. 3. §. 4. N. 1, 2, 3. §. 5. N. 1.

The two species different only apparently.

8. As to the lucid rods I affirm, that they are produced from the reflection of the rays, emitted from the lucid matter, which is not in the place where we observe the rods. Whatever we see is by the means of rays, either direct, refracted or reflected: If the rods were seen by direct rays, their lucid matter, extended in length, must necessarily be, 1. In planes vertical to any spectator; but these planes in the places of other spectators are inclined to the horizon; it would therefore, follow that the matter is every where in vertical and in inclined planes at one and the same time, a thing impossible. 2. This matter, in parts removed from the spectator, must be broader, and in nearer distances proportionally more slender: For, otherwise they could not every where appear equally broad^e; but according to the different spectators this variety of breadth should at the same time be various, as appears from optics, and the matter should be disposed according to the situation of the places, which different spectators,

The lucid rods accounted for.

^b § 4. *supra* N. 1.

^c § 4. *supra*.

^d § 6 *supra*.

^e § 4. *supra* N. 12.

^f § 4. *supra* N. 13.

tors occupy; but that is impossible, and therefore the direct vision of the rods is impossible. If instead of different spectators you assume some *phenomena* observ'd at different times by the same spectator, the same conclusion must be made: For, there is no reason, why all the *lights* are always dispos'd in a constant direction to the same spectator. If it was by refracted vision, the lucid matter which is now kindled and again extinguish'd^g, which is agitated by winds^h, which leaves gross vapours behind itⁱ, and which flashes^k, must lie beyond the region of the refracting vapours. But all these things seem not to agree to that region. I add, that the sun, moon, or the brighter stars should likewise at some times produce such rods, by refraction, which yet never happens in this manner; nor can it be shewn by optical principles, or by similar cases how it can be done: And thus likewise refracted vision is excluded, and there only remains reflex vision, which was the thing to be proved.

The place of the
lucid matter,
where?

9. As to the place of this lucid matter I affirm, that it is in that region of the air, where the clouds usually stand: For, the inferior obscure edge of the arch, to which the lucid arch is always contiguous, is to be reckon'd a cloud or vapour^l, and that principally, because it is agitated by the winds^m; seeing besides, the *light* itself is wont to run into the cloudsⁿ, nay, appears under the form of a *nubecula* or lucid vapour^o, and becomes denser towards the horizon^p. It appears that this matter has all the conditions of clouds, and consequently their place and distance from the earth.

The figure of the
inferior surface of
the clouds.

10. That we may be able to form some more conclusions, I shall adduce some subsidiary propositions from physics; the first of which let be this: The clouds do hang in calm air in such sort that their inferior surface is plain, and every where equidistant from the centre of the earth: For, since the specific gravity of the air in equal distances from the earth's centre is the same, but the clouds, which consist of vapours of the same kind, stop there, where their specific gravity coincides with that of the air, it is plain that the clouds rest in that place which is every where equidistant from the earth's centre, and consequently are expanded into a plain, parallel to sense to the earth's surface, and that the more exact, the calmer the air is.

Vouch'd from
experience.

11. This proposition is vouch'd from experience, by which it appears that the nearer the clouds are to the horizon, their base, which is always parallel thereto, is the more rectilinear: The reason of which is, that the inferior plain of clouds, placed at a distance, is seen sideways, and thus it appears like a line.

From reason.

12. It appears, besides, both from reason and experience, that clouds hang over clouds: that is, that the plain of one cloud is at a greater distance

g § 5. *supra* N. 3 & 4. h § 6. *supra* N. 5. i § 5. *supra* N. 3. § 6. N. 2.
k § 5. *supra* 7. l § 4. *supra* N. 10. m § 6. *supra* N. 5. n *Ibid.* N. 2.
o § 5. N. 2. p *Ibid.* N. 10.

tance from the earth than that of another, which is sometimes evidently observ'd upon the appearance of the *northern light*^a.

13. Another *lemma* is, that objects which are equally high in the air, seem the nearer to the horizon, the more remote they are from the eye of the spectator; and on the contrary, objects equally high, the nearer they appear to the horizon, they are likewise the more distant from the eye of the spectator: These things we have borrow'd from optics, where they are rigidly demonstrated.

The appearance of objects as they are near the horizon or remov'd from the eye.

14. From the former *lemma* is also understood the following; if a line be pendulous in the air, placed at a distance from the vertex, and be extended along a parallel to the earth, and be equally distant from it, it will appear under the form of an arch, in the manner as the arch of the *northern light* does^r: And on the contrary, if a line at an equal distance from the earth appear under the form of an arch, whose greatest height is exactly towards the north, it will be extended in the air in a parallel to the earth. These things will be easily understood by such as are acquainted with optics; for which reason I may at present wave the demonstration.

The appearance of a line in the air, parallel to the earth.

15. Supposing these things, I affirm that the matter of the *northern light* is dispos'd in the air almost in a parallel to the earth: For, this matter lodges in the region of the clouds^c; it is, therefore, equidistant from the earth^t: It moreover appears under the form of an arch, whose greatest height is directed to the north^u: And hence by § 14 it follows, that it occupies a tract in the air extended in a parallel to the earth; but I say nearly: For, the curvity of the northern arch is not always very exact^v.

The position of the *lumen boreale* in the air.

16. It is, moreover, well known from optics, that a body of an irregular and unequal figure is thought to have a more regular and equable figure, the more it is remov'd from the eye; and hence we understand, why the northern arch appears the more compleat, the nearer it is to the horizon^w: For, in that case it is more remote^x.

The appearance of an irregular figure at a distance.

17. If a number of bodies be at random dispers'd and thrown in any plain, they will likewise appear to the eye as disjoin'd, if it happen to be placed perpendicular to that plane; but the more the eye views this plane obliquely, the objects will seem to come the nearer to each other; nay, at length they will appear to form one continued body: In like manner the light or colour of each object will be increas'd and become more saturated. These things again I suppose as very certain from optics.

How bodies scatter'd in a plain appear to the eye in different positions.

18. The plains of the clouds about the vertex are view'd perpendicularly, but those which incline to the horizon are view'd at a distance and obliquely. This *lemma* is understood from § 10. 11.

Appearance of plains of clouds about the vertex and in the horizon.

19. On these I build the following proposition about the *northern light*; the matter of this *light* is disjoin'd; and dispers'd among bright *nubeculae*.

The *lumen boreale* accounted for.

But

^a § 4. *supra* N. 22.
supra N. 1. 2, 3, 4.

^r § 4. *supra* N. 1, 2, 3, 4.
^v § 4. *supra* N. 6. ^w *Ibid.*

^t § 9. ^u § 10. ^x § 13.

But the former species of the northern light appears continued^r and clearer^s, on this account, that in this case the matter of the *light* is viewed at a distance and obliquely: For, since this matter is diffus'd into a plain parallel to the earth^a, it appears in the vertex in the manner in which it is diffus'd; but it appears disjoined by §§ 17. 18. and therefore it is disjoined^b: Besides, since the former species only differs in appearance from the latter^c it necessarily follows, that the matter of the former species is also disjoined: The matter, therefore, of both species is dispers'd into lucid *nubeculae*: But the former species always inclines to the horizon^d; and therefore, it is view'd obliquely^e: It must, therefore, necessarily appear continued and brighter^f. Q. E. D.

The different phenomena of both species how explain'd.

The phenomena of the rods accounted for.

20. From what has been said it appears, in what manner the *phenomena*, by which both species differ from each other, may be explain'd.

21. Now in order to explain the *phenomena* of the rods, I shall premise a proposition or two; 1. If any lucid point do from above illuminate a horizontal plain somewhat wavy, and consisting of polish'd parts, and reflect the rays to the eye, then it will appear to the eye as a line or lucid rod, which from the lucid point is extended in a right line to the eye: This proposition may be demonstrated from optics; and we even learn it from daily experience: For, the moon or any bright star irradiating the surface of still water, represents to the eye such a rod as I have been describing.

Farther accounted for.

22. On this is founded another proposition, namely that the inferior surface of clouds or vapours do again reflect downwards, in the form of a lucid rod, the lucid points that shine upwards: For, the inferior surface of the clouds is wavy, plain, and consists of aqueous or polish'd icy particles^s; but besides, I learn'd the truth of this proposition by experiment: For, I happen'd in the night-time, upon occasion of a fire at the distance of 2 or 3 versts from my lodging at *Petersburg*, to run to the window with a friend of mine; and upon lifting up our eyes to the heavens we both saw a glowing rod, extended from the quarter of the fire to our eyes or to the *vertex*, and reflected by snowy clouds, and now increasing and again decreasing, according as the burning increas'd.

Farther confirm'd by a phenomenon of the sun.

23. This proposition is confirm'd by another *phenomenon*, which is not so uncommon at *Petersburg*, as in *Germany* or *France*: It happens sometimes in winter, that the sun, either rising or setting, is thought to project vertically upwards a lucid and whitish tail, and it is described in the *Memoirs* of the *Royal Academy of Sciences* at *Paris*^h, and it was very like that which was form'd by the above burning: For, this tail arises from the solar rays reflected upwards from the horizon into plains of vapours consisting of icy particles, and reflected to the eyes of the spectators, entirely in the same manner in which the lucid rods are produced on the surface of waterⁱ.

Having

r § 4. N. 1. z § 5. N. 9. a § 9. 10. b § 5. N. 2. c § 7. d § 4. N. 5.
e § 18. f § 17. g § 10. h An. 1703. p. 78. i § 22.

Having premis'd these things, I say that the rods of the *northern light* arise from the reflexion of the light in lucid *nubeculae*^k, namely as these *nubeculae* project the rays upwards into plains of very subtile vapours standing above each other, from which it is again reflected under the form of rods; the rods arise by reflection^l; therefore, from lucid *nubeculae*^m: For, there is no other light at that time in the air, and the brightness of the rods continues as long as the flashing of the *nubeculae*ⁿ. But the reflecting plain of the vapours is above the *nubeculae*, as appears from the alledged *phenomena*^o; consequently, it forms the rods in the manner mention'd § 21, 22, 23. By this proposition are explain'd the *phenomena* § 4 n. 11, 12, 13, 14, § 5. n. 6.

The rods arise from the reflexion of the light in *nubeculae*.

25. If we, moreover, suppose that both the plains that hang over each other and the lucid *nubeculae* may be agitated by a gentle wind, we shall easily explain the *phenomena* § 4. n. 16, 17, 18, 19, 20.

Some other *phenomena* of this light accounted for.

26. In like manner because the lucid matter has above it vapours which it illuminates, and below it none, the reason of the *phenomenon* § 4, n. 9. is manifest.

Another *phenomenon* accounted for.

27. If liquor contain'd in any vessel be on its upper part agitated towards any point, the inferior part of the liquor at the bottom will move to the contrary point: The truth of this is easily made appear both from reason and experience. It is, moreover, easy to conclude how the *phenomenon*, alledged § 6. n. 5. may be produced.

Another accounted for.

28. The explications hitherto advanced I take to have some degree of certainty: But there remain behind other *phenomena*, whose explication I promise not to be so certain. I shall declare, in short, my opinion of them, after premising some subsidiary propositions.

Other *phenomena* not so easily accounted for.

29. I think it is evident from lightnings, that the air is all over full of inflammable spirits or very subtile vapours from the continual exhalations of the earth, abounding every where with sulphur, nitre and salts; from the *caput mortuum's*, which extract from the air vitriols, salts, &c.

The air full of inflammable spirits or subtile vapours.

30. If such inflammable spirits be copiously collected into too narrow a space, they take fire and burn spontaneously. This proposition is likewise prov'd by many physical experiments commonly known.

How they come to be collected and fir'd.

31. By chemistry we likewise learn, that the more subtile spirits are contracted by cold into a less space; some with greater ease and others with greater difficulty. I speak not here of that collection of spirits, by which they are condens'd and reduced into a fluid form, but of that only whereby they are brought into a narrower compass.

Accounted for chemically.

32. While the sun recedes from the equator towards the south, the northern regions of the air become cold, and that the more, the more northerly they are, and the farther the sun removes: Besides, the regions

From the absence of the sun:

M 2

of

^k § 19.
11, 22, § 12.

^l § 8.

^m § 19.

ⁿ § 4. N. 15. § 5. N. 5.

^o § 4. N. 9, 10,

of the air of the same parallel or climate, are affected with almost the same degree of cold, I say almost: For, there are also other concurring causes besides the sun; yet, doubtless, the absence of the sun is the principal cause of cold. This proposition is manifest, and stands in need of no farther proof.

These inflammable spirits mix'd with watery vapours.

33. To these I subjoin a proposition, which indeed I cannot pretend to be very certain; yet I am oblig'd to suppose it, on account of what is to follow; and it is this; inflammable spirits are by means of heat blended and intangled with aqueous vapours; and they are afterwards separated again upon the accession of cold, as watery vapours unite sooner than inflammable spirits.

By the action of the sun or warm winds.

34. Now I say, the sun being in the northern regions, or hot winds blowing, the air is heated; and the subtilest aqueous vapours are mounted into it, and mix'd with the inflammable spirits^p: Upon the recess of the sun to the south, the succeeding heat, equally distributed in the same climate^q, collects the inflammable spirits, blended with the aqueous vapours, into very subtile *nubeculæ*^r, from which the inflammable spirits gradually extricate themselves, and are collected above them^s, a sufficient quantity of which being collected takes fire and burns^t; and this being consum'd, new store is collected and set on fire: And thus the same scene is represented for as long a time as may be. And to this I think agrees what *Wolffius* has said, when he call'd the matter of the *northern light* the *immature matter* of lightning.

35. From what has been said we easily understand the generation of the lucid matter^u; the disposition of the same, according to the tract of any climate^x, and the so often repeated accension and extinction of the lucid *nubeculæ*^y; and probably also the repeated flashes in summer time have a like original.

Other phenomena accounted for.

36. As the aqueous vapours are successively depriv'd of the inflammable spirits, they become heavier, they subside and become visible; and supposing this and what was mention'd above § 17, we understand the reason of the *phenomena* § 4. n. 10. § 5. n. 3, 4. § 6. n. 2.

The distance of the lucid matter from the earth determin'd geometrically.

37. In this manner I have in some measure explain'd almost every thing which usually relates to the *aurora borealis*: But the matter is more copious than that. I could have entirely exhausted it; I have been, therefore, forced to say a great many things concisely for brevity's sake. If opportunity and the subject bear it, I may some time hence enlarge on the distance of the lucid matter from the earth: For, I can determine it geometrically, the altitude of the arch and the horizontal amplitude of the legs being given, and if you also allow of the hypothesis I advanced above § 15: For, let the sine of the elevation of the pole be = q , the sine of the greatest

^p § 29, 33. ^q § 32. ^r § 19, 31. ^s § 33. ^t § 30. ^u § 19.
^x § 15. ^y § 5. N. 3, 4.

greatest altitude of the arch $= m$, the sine of half the amplitude of the legs $= g$, the semidiameter of the earth $= a$, and the sine of the angle, which is equal to the greatest altitude of the arch and the altitude of the equator taken together be $= b$; thus the distance of the matter in the

vertex of the arch from an observer $= \frac{2amggg}{r \times rrb - ggg}$. The invention of this

rule and its application I shall give on some other occasion.

38. At the close of this Essay I thought fit to note, that the northern light was equally known to the ancients as to us. There were some who reckon'd it in the number of prodigies, and others took it for a meteor; and they investigated its cause. Among the latter is *Aristotle*, who in his

The northern light no uncommon thing to the ancients.

meteorology^a describes it very clearly. The light I call vertical he compares to the flame of straw burning in an open place; and he calls the

tremulous flames, αἶγες, *capræ*; and the other arch'd species, *chasma*, a term usual at that time and borrow'd from the interior black space of the arch, which fittly represents a gulph, and he calls the rods, which he says ascend from the *chasma*, δοκοί, *trabes*. *Pliny*^b in his *Natural History* does

also describe most of the *phenomena* of the northern light. Such as reckon'd this meteor, as a thing extraordinary and surprising, are many in number.

I shall add two ancient testimonies, supplied me by *M. Bayerus*: The first is extant in the *Chronicon Edeffenum*^c (which is found in *Jos. Simonii*

Assemani Biblioth. orient. Tom. I.) in these words: 'In the year of the

Seleucidæ 813 a great fire was seen in the north, which burnt all night.' The other is that of *Robertus Monachus*, who in *Lib. V. Historiarum Hierosolymitanarum* for the year 1097 thus speaks; 'in that night a comet

'sparkl'd amongst the other stars of heaven, and produced the rays of its light, and a fiery redness flash'd in the heavens between north and east.'

I add to these *Marcus Squarcialupus*, who in a dissertation on comets has given a pretty good figure of the light, along with the following description of it. 'The sky in 1575 at the time of vintage in the month of October

'burnt for the whole night; or seem'd to burn; a thing never before seen by me; and, indeed, dreadful to all mortals: A great light, the moon

'being hid, arose in *Silesia* and *Sarmatia*, like the dawn of the morning; There was in the horizon a part rais'd and lengthen'd into an arch; and

'from that lucid tract, from its uppermost extremity, large rays, now in one place, and again in another, burst out in right lines: Which rays

'either stood for a long time immoveable and in form of a top, or they were dissipated, and new ones immediately issu'd out, and (which I

'view'd with surprise) from the intervals of the rays broke out large tremulous flames, which immediately mov'd very swiftly one after another

'to the vertex; in which place not a few remain'd for some time; and again some evanish'd. I saw in the dead of the night from both extre-

'mities

^a *Lib. 1. cap. 4, 5.*

^b *Lib. 2. cap. 26, 27.*

^c *F. 407.*

‘ mities of the *light* rays hurrying to the zenith and driving full-butts
 ‘ against each other like two armies; and at the zenith there was a jutting
 ‘ and confusion of the rays, advancing and charging on their adversaries;
 ‘ and again retiring, mounting and writhing themselves with an incredible
 ‘ variety of colours, as scarlet, violet, yellow and red. In this fight and
 ‘ engagement in the heavens, the eastern part giving way, the western
 ‘ rays appeared the more powerful and victorious: And credulous people
 ‘ affirm’d, that a bloody war between us and the *Turks* was at hand, &c.’
 And hither I think are referable most other relations both ancient and modern about *armies*, *spears*, *military armour*, &c. seen in the heavens.

A remedy in an atrophy of the eye; together with observations thereon. By Joach. Georg. Elsnerus. *From the Miscellanea Naturæ Curiosorum.* An. 1. Dec. 1. Obs. XII. p. 37.

Translated from the L A T I N.

A remedy in a
wasting of the
eye.

AN atrophy or wasting of the eye arises either from a defect of the nutritious juice, from a discontinuing of a due degree of moistening, or from an excessive waste of spirits. This disorder, it is true, is rare and very difficult to cure; and in it medicines taken by the mouth, can scarcely be of service: But a moistening specific remedy must be applied, to be externally drop’d into the eye; as appear’d from a beginning atrophy in a young man, who was otherwise naturally dry, and who had got this disorder by excess in venery and by hot provocatives thereto: So that the ball of his eye seem’d to be lessen’d, together with a dryness and a slight heat with pain. And upon applying to me for advice, a singular moistening and cherishing medicine, in disorders of the eye, seasonably occur’d to me; and which a few weeks before I discover’d by chance in dissecting the eye of a woodcock, which when I had squeez’d too much after a deep incision, I made the aqueous humour to squirt into my own eye; whereby it was moisten’d and my eye-sight improv’d; and I found it to relieve the pain and dryness with which my eye was then affected by too much poring. Upon this I advis’d the patient to drop into his eye this liquor, collected from the eyes of woodcocks and others of the cock kind; and use for his diet pullets boil’d with endive: And moreover to abstain from excess in venery, and from the use of too hot medicines and food: And thus I brought about that his eye-sight was soon improv’d, and that the balls of his eyes were restor’d to their former plumpness.

Scholium.

We are to observe, 1. That if we are to use this humour in medicine, it is not necessary, that it be always taken from the eyes of woodcocks: For, in my opinion, that from other animals, especially such as are more sharp-sighted, will have the same effect.

2. I reckon this natural composition to excel many of the most expensive chemical liquors.

3. If any one has an opportunity of collecting this humour from the eyes of animals, and if he is only careful to conserve it, by using other things, which shall not lessen, but rather heighten its virtue, he will really have a singular remedy, and he may mix it up with other specifics to improve it still the more.

4. While we are treating of the eye and of a liquor appropriated to many disorders thereof, we may carry our speculations higher, and examine whether this liquor can be of service, when the humours of the eyes are vitiated and exhausted. No one will readily doubt of the restitution of the aqueous humour: For *Galen*^d has seen its regeneration; and *Coiter* has likewise observ'd it^e; and *Benevenius*^f also adds his suffrage, and *Schenkius*^g has illustrated these instances with some others. Now if nature be spontaneously employ'd in restoring the lost aqueous humour, it will the better succeed by the co-operation of this truly appropriated liquor.

Nay moreover, I have no doubt but it may be also serviceable in restoring the vitreous humour: Yet its effect would be greater, if it were daily applied along with the vitreous humour; because *Duncan Liddel*, an excellent physician, formerly supplied the defect of this humour by the whites of eggs; and that not without reason, because the vitreous humour is entirely similar to the whites of eggs, and these last are a vulnerary; and by consolidating the coats they may effect the regeneration of the wasted humour. Thus *Henricus ab Heer*^h writes, that he restor'd both the vitreous and aqueous humour to a cock, and also to a certain young woman by the juice of meadswheat, collected in the month of *May*. Whether it may also be of service to restore the crystalline humour, will indeed be very hard to determine; for, almost all who have hitherto applied themselves to this, seem unanimously to despair of the restoration of this humour; except a few, who, by the acuteness of their genius and their indefatigable labour, have arriv'd to such a pitch, as after destroying the three humours to effect, by pouring in the juice of celandine, not only the restoring all the humours, but even the sight to its pristine vigour. *Caspar Schottus*ⁱ has a few years ago furnish'd us with an experiment, affirming that it was perform'd at *Prague* by a certain ingenious *Englishman* in the presence of *Dr. Marcus*; but which is more, about a year ago *Franciscus Josephus Burrhi* in a letter to *Thom. Bartholin* has not only describ'd this experiment, but has exactly delineated the secret, and by what artifice the humours are to be squeez'd out, and in what manner they are to be restor'd; and he has confirm'd the truth of this invention by many experiments: And that very accurate observer *Thom. Bartholin* writes to *Philip Jac. Sacks à Lewenheim* in

^d L. 1. de sympt. caus. cap. 2.

^e In Obs. medicis.

cap. 22.

^h Obs. spad. 4.

^c In. Obs. Anat. chir.

ⁱ In tech. curios. lib. 11. mirabil. Miscellan.

^f Cap. 74. de abd.

in a letter, dated *September* 30, 1669. to the following purpose; ' I doubt not but you have read of the contrivance of restoring all the humours of the eyes, of which the illustrious *Burrbi* writ to me: The experiments succeeded in a goose, tho' the wound made in the eye was somewhat with the deepest.' From which it very clearly appears, that it is possible by art to restore even the crystalline humour: But supposing this humour may be restor'd by art after squeezing it out by a skilful hand; yet if it be squeez'd out by chance, it is hardly possible to restore it.

For, a wound, made by chance or by a blow, is given with some violence; whereby it is impossible but that either the optic nerve must be hurt or the deeper fibres, which spring from the optic nerve, or the coats; which being hurt even in an artificial expression, no restitution can be hop'd for.

An observation about the proportion of the constituent parts of the Blood. From the Acta Eruditorum. An. 1682. p. 126.

Translated from the LATIN.

The constituent parts of the blood.

THE mass of blood consists of three parts, to wit, an aqueous *serum*, a gelatinous or fibrous substance and a ruddy tincture, or the blood, by way of eminence, so call'd: But because in the blood, drawn off by venisection, and afterwards coagulated, the abovementioned gelatinous portion is partly entangl'd in the ruddy tincture, and contributes to its thickness, and partly is dissolv'd and diluted by the aqueous *serum*, there has hitherto been observ'd and suppos'd only a twofold substance, to wit, the ferous and red part; till about the middle of the present century a more accurate examination of this animal fluid had discovered that gelatinous nutritious substance; but what proportion it bore to the other constituent parts of the blood was design'd for further enquiry: I was, therefore, for some time in great doubt about the organ and manner of sanguification; or rather I conjectur'd, that possibly the proportion of the red part was but very small, about whose efficient cause and manner of production such disputes were rais'd among Anatomists of great note, and which requir'd such an apparatus and compass of *viscera*, as the liver, spleen, heart, &c. towards sanguification: Besides, by the microscope are observable in the blood ruddy globules floating in the limpid *serum*; and upon comparing the mass of these globules with that of the *serum*, I found the former very unequal, and by far less in quantity than the latter: Yet because it is probable, that still much of this gelatinous substance is entangl'd in these red globules; nay as it was very certain, that I could not take upon me to distinguish and determine barely by the eye how much of this ruddy tincture was still remaining in the vital blood; by the help of other contrivances I found in different animals and likewise in different human

man subjects, that the proportion of the *serum* and gelatinous part is to the red tincture, sometimes as 10, sometimes as 11, and sometimes more parts, but never fewer, to one part of the said tincture: But the last experiment, which I made on account of this theory upon the blood of a very found person, was as follows; to wit, I suffer'd so much blood running out of an open'd vein to mix with a pound of warm water, till I observ'd the weight of the water to increase three ounces and a drachm: Hence so much blood was absorb'd and diluted by it. Upon filtering this solution, it left behind in the strainer half an ounce and a drachm of a more viscid gelly, while the remainder of it yielded by a gentle distillation a pound, an ounce and six drachms of an aqueous substance, with two drachms and a half of a dark red, grumous part, remaining at the bottom of the retort: So that three drachms and a half of the aqueous substance was either imbib'd by the filtering paper, or exhal'd in distillation. Yet because the different colour of this *cruor*, which I observ'd by the microscope, shew'd that it still contain'd some small matter of the gelatinous parts, I again macerated in warm water that little mass, that I might elixate all the gelatinous part, and I afterwards filter'd it; and after a gentle evaporation, there only remain'd of the grumous part or red tincture, two drachms and three grains, that is, scarcely a twelfth part of the sanguineous mass; which, therefore, shew'd, that what gives it the species and name of blood is very small in proportion.

Of the Ore of Quicksilver. By Erick Odhelstierna. From the Acta Literaria Sueciæ. Trimestre tertium Anni 1720. p. 59.

Translated from the LATIN.

QUICKSILVER, as has been long since known, is found in its own peculiar and proper ore, as other metals are: And indeed, in the mine at *Idria* (subject to the archdukes of *Austria*, and so abounding in this metal, that all the quicksilver employ'd in *Europe*; nay, and a great part of that us'd in *America* is principally prepar'd here) it grows in such sort in its own peculiar grooves and veins, that, besides this metal, there is no other found there; and even the very recrement of the vein, after the quicksilver is separated from it, and the *minium*, which we call cinnabar, contain nothing besides a lean and insipid earth, entirely void of all other metal; nay of any mineral, at least manifest and perceptible to us; neither is it observ'd in other grooves but very rarely, nor is quicksilver found in veins along with the nobler metals, as they are call'd, nor even with the baser ones; at least, for my particular, I never happen'd to see it, while I visited the metallic mines in foreign countries, which are wrought

Quicksilver found in its peculiar ore.

at this day; nor could I get any clear or certain account either from the miners or inhabitants about it: Yet I own there is some mention made of this thing in the writings of good authors, who have treated of metallurgy; for, I have found the following words in *Job. Matthesius*: ‘In that valuable and rich vein of St. *Laurence* groove, as also in the drift of St. *Dorothea* at *Schottenberg*, was likewise found a rich ore of mercury; and besides, from the mines at *Plana* in *Bohemia* there was transmitted to us a pure pellucid ore like a carbuncle, and taken for rude red silver; but it was really found to be quicksilver upon its sudden evaporation along with a fume in the fire.’ And *Alonso Barba*, who has describ’d the metals of *America*, relates, that a certain ore from a mine of *Chalatiri*, four leagues distant from *Potosi*, upon fusing it, yielded a large mass of silver, considering its bulk; and besides, that in the less warm corners of the smelting furnace quicksilver was observ’d: Upon which the miners ever after treated this ore in a different manner; to wit, in that other manner by which quicksilver is usually extracted from its peculiar stone; and they obtain’d a greater quantity of it, than even that noble ore of *Guaneavillia* could ever yield.

Why mercury is not found in Sweden.

But there have been many obstacles why we could not expect to find any such thing in *Sweden*; for, the intense degree of cold, which prevails in our parts for a great part of the year, seem’d to many to hinder by its force and efficacy the subterraneous exhalations; and besides, an abounding *acor* and a predominant sulphur, with which our country and all our minerals are impregnated, and that far more plentifully than in other places, seem’d to suppress those vapours, that they might be fixt in their ascent, and consequently lose by this means their fluidity.

Yet some found it at *Sahlberg*.

Yet we were told by men of credit, that when about the year 1660 two adventurers at their own private risque sunk that shaft in the great mine at *Sahlberg*, call’d *Penninge-shaft*, about the places of that groove, which have the name of *Futbylls-felt-orten*, upon breaking thro’ the rock they fell on a certain bluish earth, that was dense and very close; and upon opening it, quicksilver trickled out of it.

And afterwards in greater plenty.

We are likewise told, that in the year 1689, when in the above-mention’d groove, *Futbylls-felt-orts-shaft*, an impending rock on the west side had tumbled down, being almost 100 ton in bulk, and afterwards as is common, when the rubbish of the rocks was broken to pieces, the workmen observ’d something of the quicksilver, but trickling in such sort among the fragments of the veins, that but a very little of it could be collected; and thus the matter lay unregarded till of late, to wit, in 1696 in the abovemention’d place, represented by g, a certain digger in search of the veins observ’d drops of quicksilver plentifully trickling down. At the same time, and in the same place a small stone, of five ounces weight, was cut out, which manifestly transfused drops of quicksilver, and view’d by the

Plate III. Fig. 1.

micro-

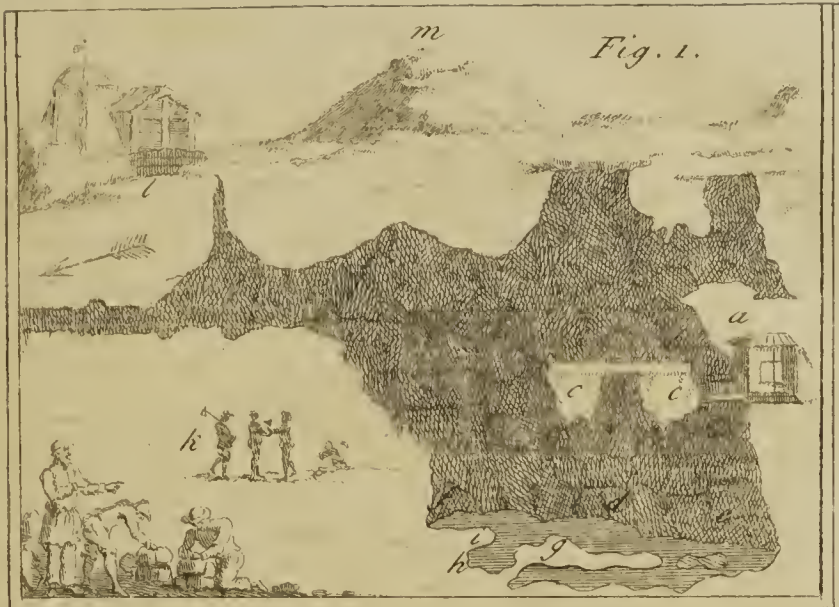


Fig. 5.

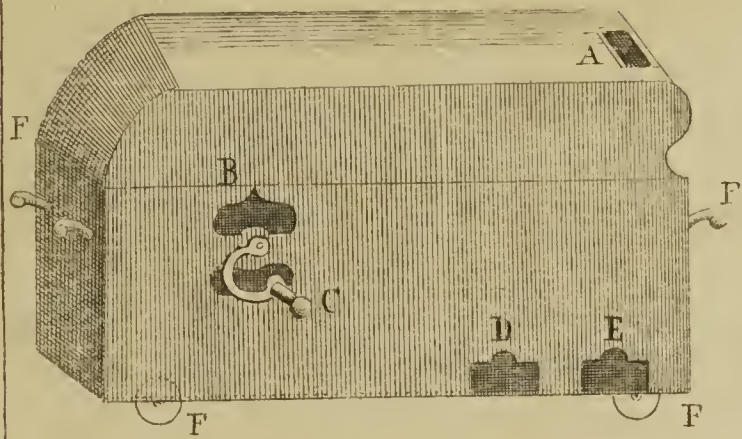


Fig. 6.

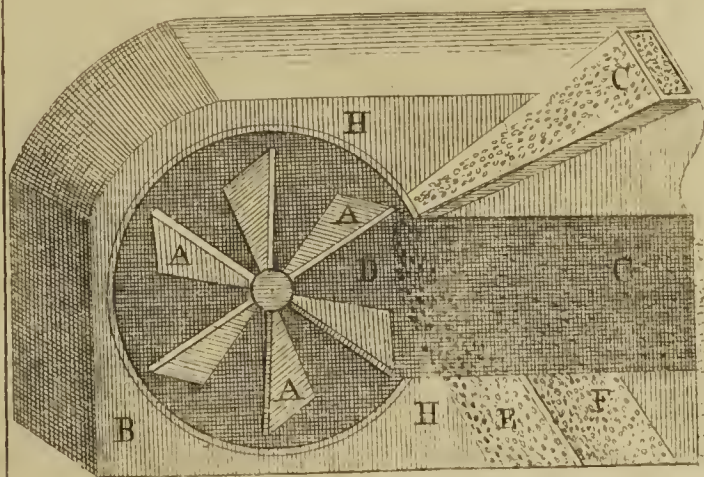
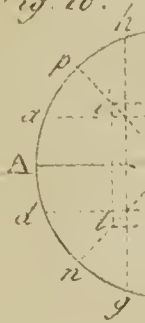


Fig. 16.



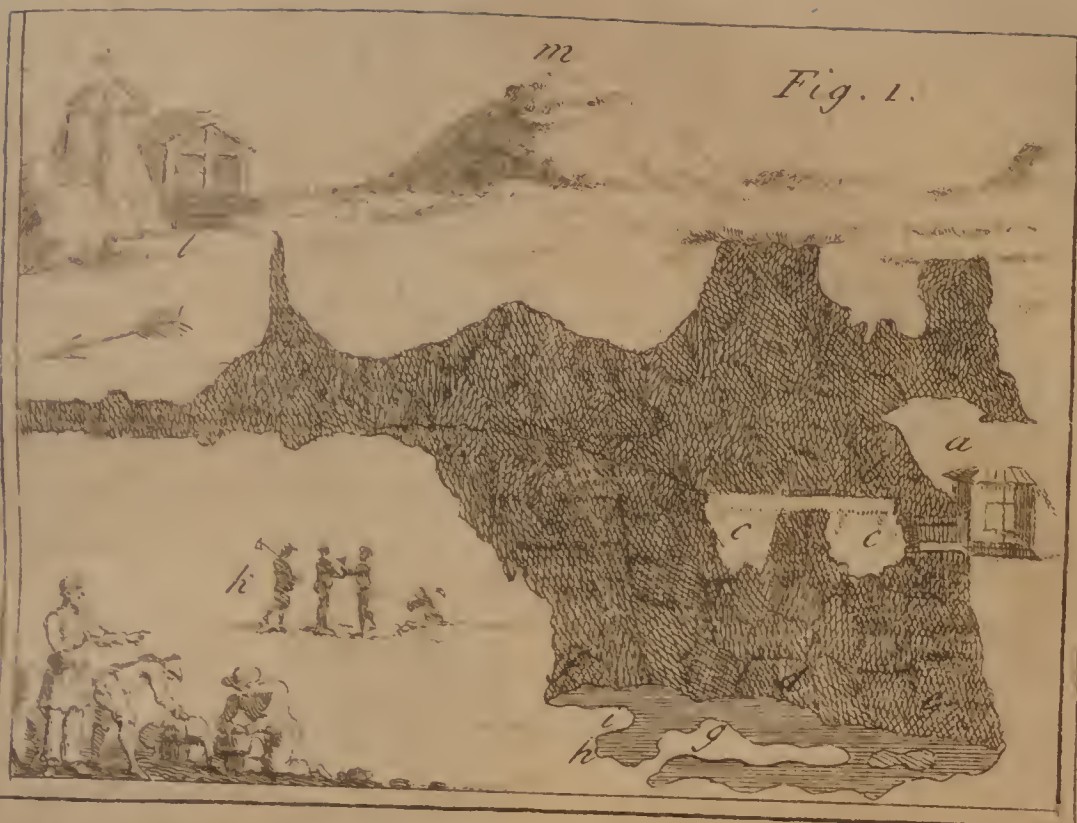


Fig. 1.

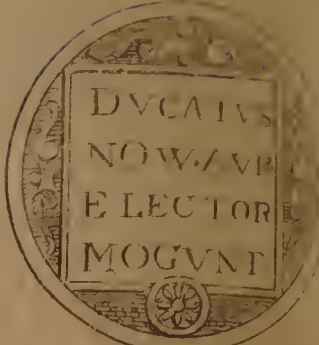


Fig. 2.

Fig. 3.

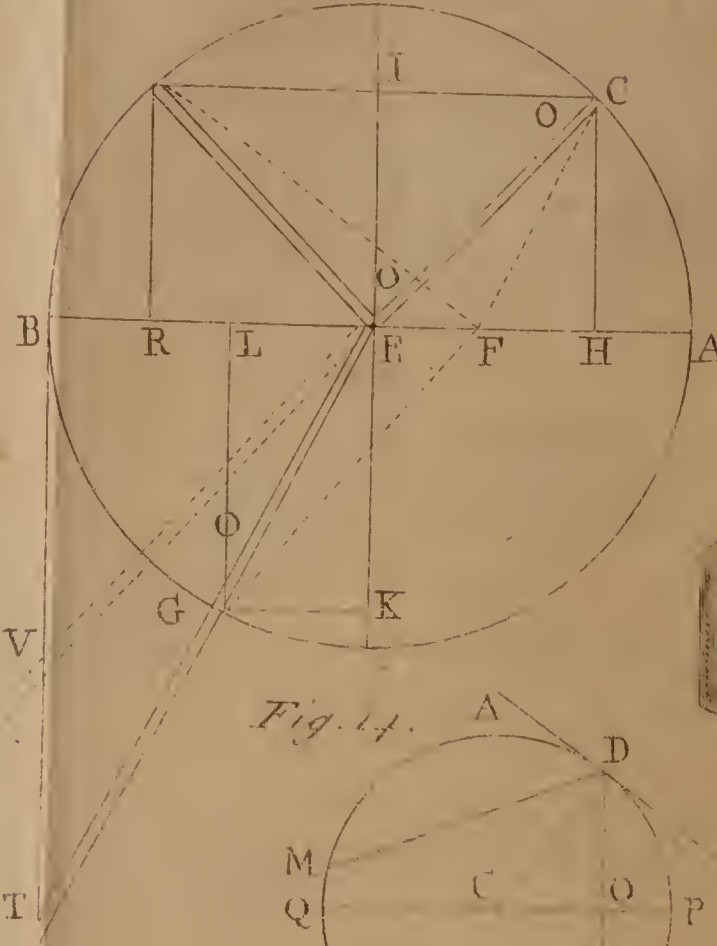


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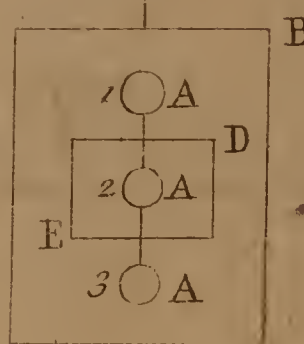


Fig. 7.

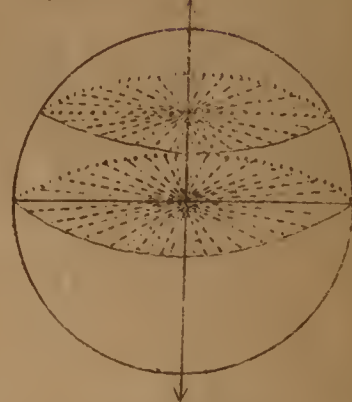


Fig. 5.

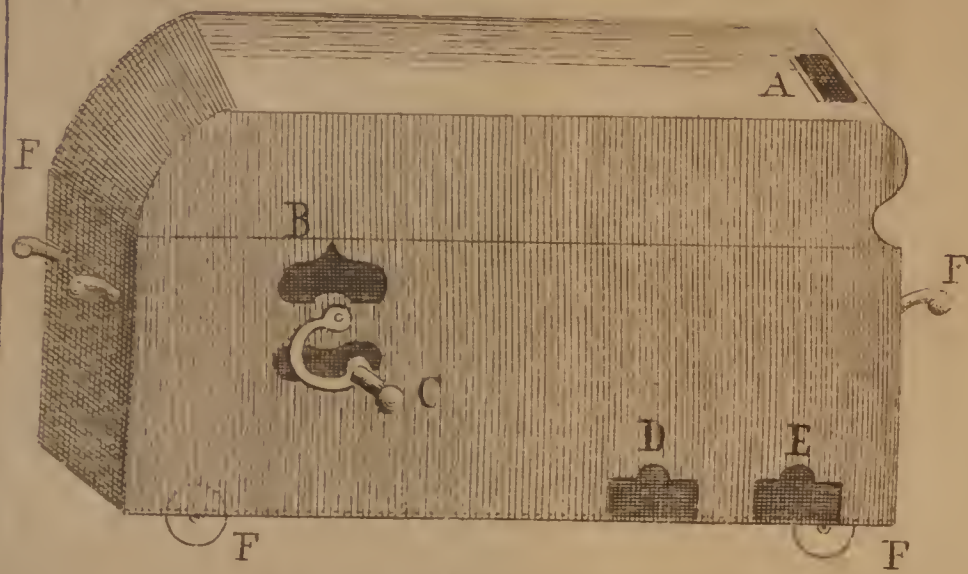


Fig. 9.



Fig. 11.

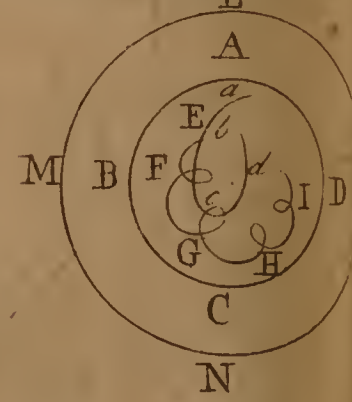


Fig. 8.

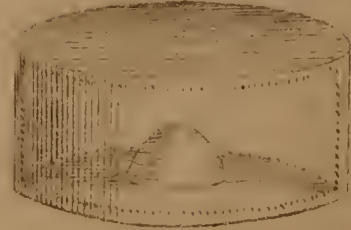


Fig. 14.

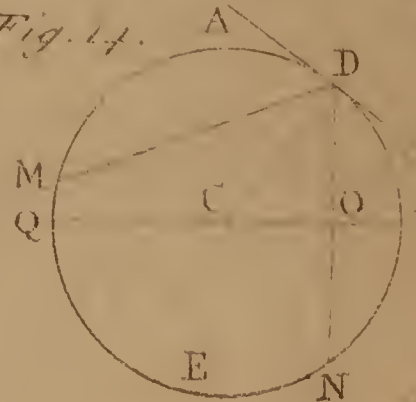


Fig. 10.

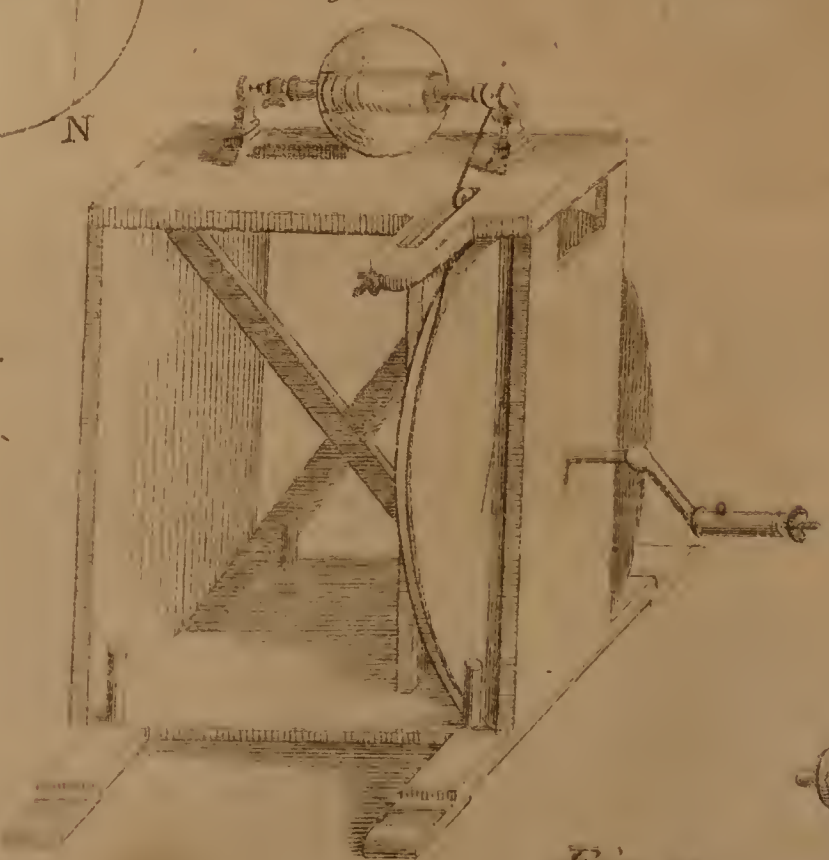


Fig. 12.

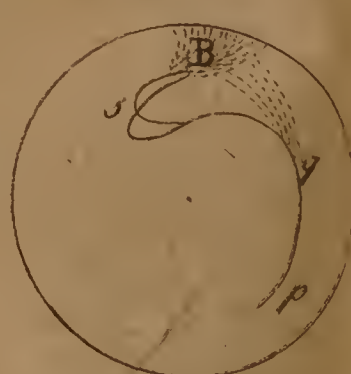


Fig. 13.

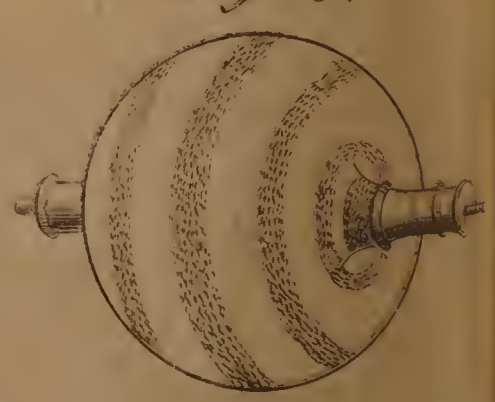


Fig. 6.

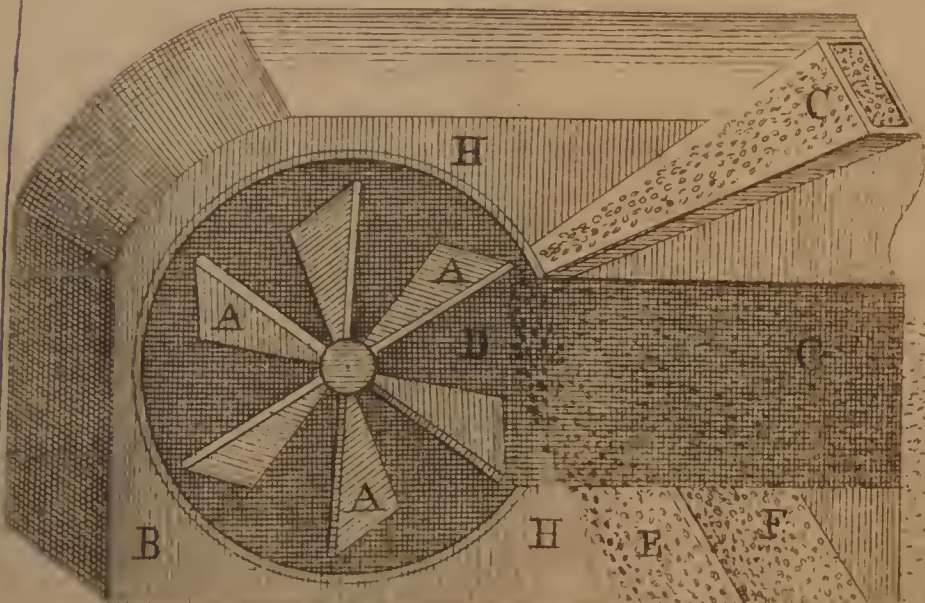


Fig. 16.

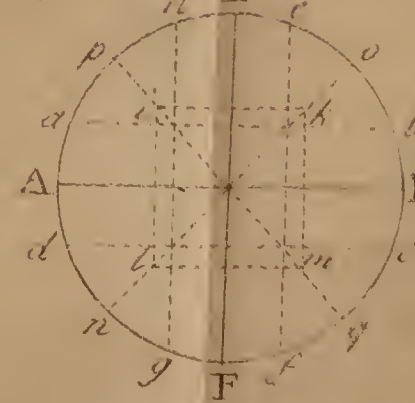
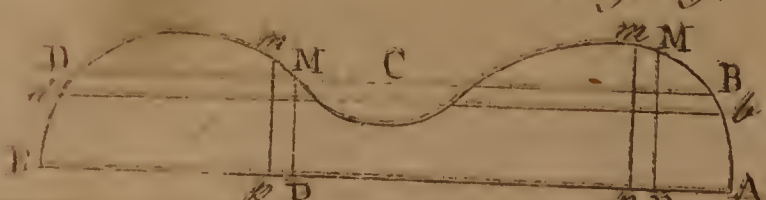


Fig. 17.



Fig. 15.



microscope, appear'd all over cover'd with mercurial globules. From this, therefore, the opinion prevail'd and was more ascertain'd, that the ore of this groove was mixt with quicksilver; which was indeed hitherto call'd in question by some, till again a stone of four pound weight was brought to me from the same drift, on which mercurial globules appear'd very thick, not only by the microscope, but to the naked eye; so that they might be struck off with the edge of a knife: But when the level was to be driven towards *b*, and without the metallic vein, which was between *d* and *i* from north to south, nothing was found but a kind of barren substance; so that all further hopes of obtaining quicksilver vanish'd, especially since now another kind of rock offer'd to the miners; and the silver vein itself was gradually struck out: In fine, if any quicksilver happen'd to adhere to the coat of the vein, it must have been quite dissipated and carried off by the continual fires, by which the rock in mines is to be split: But in the month of *February* this year, the workmen were order'd to pursue that rich silver vein, which they had before left in the rock near *d*; and consequently make their fires between *e* and *f*: Then again the quicksilver appear'd in a broken piece of 20 pound, and manifestly discover'd mercurial globules: When therefore, by this means, all doubt was at length remov'd, and it appear'd to every one, that this noble vein extended its mercurial produce farther than at first it seem'd to do, and that it was not included in small stones, scatter'd up and down the rock; upon this orders were given, that two tons of the metallic stone of the above-mention'd drift, as also a quarter of a ton of the barren rock next the vein should be brought, which, indeed, at first sight differ'd but little from the usual ore of this groove: Yet after they were brought to the test in the king's laboratory, and more closely examin'd by fire and water, we found the metal throughout all its parts to contain such a quantity of quicksilver, that tho' on account of the predominancy of the silver it cannot, indeed, be call'd an ore of mercury, but more properly a kind of mercurial ore of silver; yet it sufficiently evinc'd, that this mercury was equally diffus'd thro' all the vein, seeing it yielded such a quantity as was sufficient to compare its nature with common mercury: The ore, therefore, pursued in this manner, having sufficiently shewn that more quicksilver might have remain'd in it, had not the rock been split by fire, by which the greater part of the metal, either during the flames or after they are extinguish'd, was forc'd out by the heat remaining in the stone. The usual method by fire was, indeed, for some time laid aside, and the splitting the rock attempted by other methods; but it was so very hard and refractory, that in whatever manner the cleaving of it was attempted, the success was but little; and now as, on account of this mercury, the usual working for silver could no longer be interrupted; the workmen were again allow'd to burn out the drift, and that till some new ore casting up should make them alter

their measures; and this was the event of the attempt. Yet the following things seem to deserve our accurate and careful thoughts. 1. That this is the only subterraneous place in the *Sahlberg* mines, in which, as far as appears, quicksilver is found; and that chiefly indeed in that side which extends from *e* thro' *d* towards *f*. 2. A kind of slender fibre of a white and soft *asbestos* was observ'd all over this drift from *g* towards *b*, dividing the rock horizontally; and the same was seen in the opposite side *d*: But from *g* towards *b* the same fibre distill'd a kind of milky and peculiar liquor, several bottles of which were collected and kept; and this we call a metallic *gur*. 3. Upon examining it after inspissation, it every where shew'd traces of silver. 4. In the upper groove of this mine, as also in a deeper and lower one, silver was found in its peculiar stone, rude, white, and plated. 5. Near *g* and *i*, where likewise the quicksilver discover'd itself, several little stones were found, which only by the fire, usually employ'd in breaking the vein, had drops of pure silver spontaneously fus'd, and sticking very thick on their surface, such as the ore of *bismuth* usually shews in roasting, which, indeed, is unusual in silver ore. 6. Every vein that gave silver yielded at once four or five ounces of silver; and this in the same manner when the silver was roasted, or either before or after the mercury was separated from it. 7. The vein gave its quicksilver without any addition, whether it was powder'd small, or left in entire small pieces; yet it was more readily, and in a shorter time, driven out of these pieces than out of the powder. 8. It does not hitherto appear that the coat of the vein, or the rock next the ore, contains any mercury.

Reflections on
what has been
said.

From what has been said above, we may be led to the following reflections; 1. Whether and how far that milky liquor, which we have call'd a metallic *gur*, contributes to the growth of metal, or along with the subterraneous waters contains in itself those mineral exhalations that ascend from the bottom, and retains and fixes the same in their proper *matrix*, to wit, at that time when the above-mention'd *gur* has access to the vein thro' patent chinks; and that before it is infected and tainted with other more ignoble minerals and wild juices, whose burning exhalation afterwards hinders some prime and nobler metallic matter from taking place? 2. Whether quicksilver, however it may owe its original to other pre-existent matters, is requisite to the production of metals in a certain nearer degree than is commonly thought? 3. Whether a soft or hard kind of rock is together with the mercury requisite to the production of that rude, plated or capillary silver? Or whether such vegetation is not disturb'd by sulphureous fumes? So that thereby ores may be produc'd, if not always baser, yet quite different in appearance: On which occasion we may at the same time enquire into the difference between that virgin mercury of the vein of silver, and that commonly call'd mercury, or that even call'd the mercuries of bodies, that is, such as are prepar'd by art from metals already com-

completed? Where probably at the same time the cause of that *phenomenon* might be discover'd, which is observ'd, when the ore of lead, thrown alternately with nitrous salts thro' a retort furnish'd with a tube, is roasted, where indeed the metal is strongly dissolv'd, but at the same time the workmen are in imminent danger of losing their lives. 4. And lastly, whether we may not find strong arguments for refuting those who persuade themselves, that at this day no metals are generated? But that they still persist in the same state in which they were at the creation of the world, or at least, when by the various breaches and ruins of the earth every thing was dissipated and blended.

Of the Cure of the Bite of a Mad Dog. From the Breslaw Collection, August 1717. Class IV. Art. V. p. 169.

Translated from the HIGH-DUTCH.

AT the beginning of this month Prince *Philip* of *Bavaria* had the misfortune at *Rome* to be bit by a mad dog; and the physicians upon a consultation came to this resolution; to wit, that the Prince should be brought to the sea, and there dipt in salt water; which was accordingly done three several times; whereby, as we are inform'd, he was effectually freed from all the grievous consequences of this bite: We have sufficient reason to obviate this dangerous evil in time, without resting secure in the fond hopes, that possibly the bite was not given with that tooth of the dog, which, as some would falsely have it, is alone infected, and which others again suppose not to be noxious; a fable which deserves no more credit than the worm *litta*, said to be under a mad dog's tongue: It is certain, that without such *chimera*'s we have sufficient reason to provide against the otherwise extensive ill consequences of this bite, which either soon or often in some time, as in 40 days or more, usually brings on grievous symptoms; and in particular the *hydrophobia* or *pneughydron*, that is, the dread of water, its grand *pathognomonic*, and commonly afterwards, death. The cause of this extraordinary symptom is hitherto an insolvable secret in physic, as in the sting of the *tarantula*, the desire to dance. *Actius*^a has observ'd that mad dogs tho' very thirsty, yet dread to drink; and it is well known, and which *Josephus de Aromatariis*^b in particular has fully shown, that this madness is nothing other than a peculiar species of *angina* or *cynanche*, in which the throat and tongue are inflam'd, that when they would swallow down any drink, it causes great uneasiness; and hence it is again discharged at the mouth and nose: So that by all means they usually avoid drinking. This disease is commonly caus'd in dogs, when either in

The bite of a mad dog cur'd by dipping in the sea.

very

^a L. 6. c. 14. ^b *Tr. de rabie contagiosa*. part 2. cap. 7. in fine. and part 3. throughout.

very hot or in very cold weather they greedily lapp what is either too cold, or too warm^c: Besides, a mad dog with other symptoms has also this, that he is giddy and staggers; and consequently, on that account dreads water, tho' not for this reason, because he hates to see his own image therein.

The rise of this cure.

Nothing hitherto has been found more effectual against this bite and the whole disease, as dipping the wounded member or rather the whole body in salt water, and especially sea water: Yet with this observation, namely, that where either there is a perfect *hydrophobia*, or the wound has been unseasonably clos'd up, this means is of little or no avail, of which *Forestus*^d alledges an instance. As, therefore, the rise of this cure appears to be hence, that as the patient, even in the greatest degree of thirst, extremely avoids water and all drinks, either the physicians or other people on this occasion took the hint of curing contraries by contraries; and so violently attempted to throw the patient into the water. At first this was done only in fresh cold water, of which there is no ancients testimony, as far as we know, than that of *Celsus*^e, who says, 'the grand remedy is to throw the patient suddenly into a pond, and if he cannot swim, sometimes to keep him under water and make him drink, and sometimes pull him up again; but if he can swim, to plunge him, that he may drink whether he would or no: And thus both his thirst and dread of water are remov'd': And in this manner also *Apollonius Thyanaeus*^f cur'd the mad dog, which he threw into the river *Cydnus*, and caused swim for some time. In modern times in particular, either as the place was more commodious, or from a particular regard to the salt or some other quality, sea-water has been us'd; and that especially in *France*, the *Netherlands*, and other sea-coasts^g.

The *hydrophobia* not unknown to the ancients.

We shall only add, that this disease of the *hydrophobia* was not entirely unknown in the days of *Aristotle* and *Hippocrates*, as *Hier Mercurialis*^h has fully shewn, on which account he has been oppos'd by *Josephus de Aromatariis*ⁱ, and by *Caspar à Reyer*^k: At the least *Plutarch* expressly says, that both the *hydrophobia* and *elephantiasis* were first known in the days of *Asclepiades*, who liv'd at *Rome* under *Pompey, the Great*; Whence also *Ovid*, who liv'd but a little after *Asclepiades* testifies, that at that time there was still no remedy known against this distemper.

Nec formidatis ulla (medicina) medetur aquis.

Till at last in *Celsus*'s days a remedy was found, namely the dipping in a pond, but of which he also says, that it was the only one at that time that was wont to be us'd against it.

A new

^c Vide *Reyer camp. Elys.* qu. 61. p. 787. cap. 27. § 2.

^d Lib. 10. Obs. 28.

^e Lib. 5.

^f *Philostratus in vit. Apollon.* lib. 6. cap. 18.

^g Vid. *Forestus l. c*

Condrouchus de hydrophobia l. 2. c. 8. p. m. 200

^h *Variar. lect.* lib. 1. c. 2. p. m. 2. seq

ⁱ Part 1. cap. 9. seq.

^k l. c. p. 794.

A new Hypothesis about Vapours By J. Chauvinus. *From the*
Miscellanea Berolinensia. Tom. I. p. 120.

Translated from the LATIN.

1. **T**HAT vapours and exhalations furnish the matter to meteors, as fogs, clouds, rain, snow, thunder, &c. and that they are carried aloft and for some time remain pendulous in the air, is what we must conclude: And indeed, all philosophers unanimously do so. But how both these things happen, we shall attempt to explain.

The design of this essay.

2. And in the first place we contend; that there are, or at least that it is possible for numberless bubbles to be made up of air and water, much like those soap-bubbles which are usually produced by blowing thro' a pipe, put into soapy water; but so far are these bubbles form'd, as the air is collected, as it were, into a ball, or press'd by the circumambient water, a thin plate of which at least does continually on all hands equally press and encompass the included air; nor do I assume this without proof, for, experimental physics do not only prove, but also demonstrate, that in a natural way bubbles are made up of air and water: For, upon putting a glass-vessel half full of water under the glass-recipient of an air-pump; and afterwards exhausting some part of the air, it is easy to observe that a great many particles of air, conceal'd in the water, rise from its inferior pores to its uppermost surface; nay, and emerge a little, or run into bubbles or spherules, which indeed exhibit to the eyes of the spectators nothing other besides particles of air, cover'd over, as it were, with thin pellicles of water.

The manner how bubbles of air and water are form'd.

3. In the second place we contend, that the aereo-aqueous bubbles emerging from fluid bodies are sometimes rais'd aloft by the air, and then constitute vapours, and that from these are produced vaporious exhalations, where very subtile particles of terrestrial mixts, chiefly sulphureous or saline, are included in very fine particles of water: But they are, therefore, rais'd either as vapours or exhalations, because while the above-mentioned bubbles are formed, the elasticity of the air, of which they consist, is very much weaken'd or diminish'd; and so they are the less able to resist the pressure of the circumambient air, whose elasticity is either entire, or at least still very vigorous.

How they are rais'd in the air.

4. That these things may appear the more clearly, we are in the first place to premise, that by the elasticity of the air I understand its expansive force, by which the circumjacent bodies are press'd, impell'd, &c. In the second place that the elastic force of the air is the greater, the more its parts are compress'd or forced into a less space; and that it is the more and more diminish'd, and at length entirely destroy'd, as the same particles of air diffuse into a greater local space, till they acquire the greatest possible

And that by its elasticity.

possible degree of expansion. In the third place, that that expansive force of the air exerts itself, or unfolds more and more, so long as the circumjacent bodies do less and less resist it. And in the fourth place, that at length it is entirely destroy'd, when there are no bodies, which are capable of compressing and inflecting the particles of air: Thus the expansive force of the arms, folded together, or of the fist, clench'd close, is broken, and successively more and more diminish'd, as the arms are stretch'd out into wider arches, or as the fingers do more unfold themselves; nor at length can they dilate further, when, upon removing every obstacle, either the arms or fingers undergo no inflexion or curvature at all.

Farther prov'd.

5. After premising these things, no one, doubtless, will deny that bubbles, made up of air and water, may be forced or driven upwards by the circumambient air, nay oftentimes actually rais'd aloft, if it shall first appear, that it is endued with the greatest elasticity, or at least its elastic or expansive force weaken'd the least possible, but that the air, included in the above-mention'd bubbles, has the least degree of elasticity remaining and almost none at all: But this is made out in this manner, namely that the external air being in nowise alter'd, or preserving its elasticity entire, which at least it before had from its native constitution, the air running into a bubble expands itself as much as may be, till it is restrain'd by an involving pellicle of water, and contain'd within its compass; and of this you may be convinced by your own eyes, if you observe the particles of air ascending from the bottom of the glass vessel, mentioned above: For, in their ascent they are more and more enlarged, till they arise in spherical bubbles; but they are, therefore, increas'd and enlarged, because after exhausting the air incumbent on the outmost surface of the water, they are press'd by a less weight: And being freed from so small a weight by their own elasticity, they remove a little the water incumbent on them; and therefore, they swell a little, as it were, and as they approach nearer the surface, being still press'd by a less weight, they exert a greater elasticity and dilate themselves the more, and thus they more strongly propel the superior parts of the water; and at length in part break out, nay and very often escape involv'd in the outmost particles of the water; but as these things happen, their expansive force must be successively diminish'd, as is manifest to any one: And therefore, they are easily rais'd aloft by the incumbent elastic air.

The bubbles not rais'd by the weight of the external air, but by its elasticity.

6. Some one may perhaps affirm, that these bubbles do not consist of air alone, but likewise of aqueous particles, to which also are often added sulphureous or saline particles: And that hence we gather that these cannot be propell'd upwards so easily, nay not at all by the circumambient air, tho' considerably elastic, and tho' the elasticity of the air of the bubble be weaken'd; because the weight of the aqueous and terrestrial parts, with which the bubbles are involved, is an obstacle. But this objection is of
no

no great weight: For, the force of the air protruding upwards those mixt bubbles is not ascrib'd to the weight of the external air apart; but chiefly to its elasticity, as we have plainly hinted. The air, indeed, presses by its weight, and as by gravitating it tends downwards, it does also press and protrude downwards the bodies on which it is incumbent; and this pressure is so great as the quantity of the air is conceiv'd to be: But we doubt not to assert, as it is a thing that may be demonstrated from the swelling and breaking of a bladder, that the air has another sort of pressure from the constitution of its parts, or from its elasticity, which diffuses itself every way. But it appears by the same experiment, that the pressive force of the air arising from its elasticity is far greater than from that of its innate gravity; as in iron, wood, and other more sensible bodies, which are bent or inflected, the pressure arising from their elasticity is far greater than that from their native gravity: Whence it is immediately concluded, that the air, however lighter than these mixt bubbles, is by its elasticity able to propel and drive the same upwards, and that with a great force, till they become in *æquilibrio* with the upper air; which the higher it is, has the less degree of elasticity, so that these exhalations do then remain pendulous therein.

Chemical Gold, or the Transmutation of the baser Metals into Gold. By Philip Jac. Sachs à Lewenheimb. From the Miscellanea Naturæ Curiosorum. An. 1. Dec. 1. Obs. 17. p. 65.

Translated from the LATIN.

IT is still a dispute, whether any other gold, besides that which nature prepares in the bowels of the earth, can be produc'd by art, entirely similar to natural gold, or much more noble than it, as the philosophers by fire and the adepts would have it? There are a great many who absolutely deny it, and that for various reasons, and from the instances of so many impostures; as of some who dip into solutions of gold and silver wooden sticks, with which they stir these metals, and impregnate them therewith: Others mix powder'd coals with solutions of gold and silver: Others make an ink of gold and silver, with which they inscribe on paper the matter to be reduced: Others instead of sand, sprinkle with *calx* of gold and silver the letters written on paper: Others employ crucibles with a double space between, the lower of which is full of gold and silver, and this they break in the process: Others employ sticks internally hollow and full of gold and silver: Others fill the coals with gold, and cover the crucibles with them: Others secretly and by flight of hand throw in gold and silver: Others instead of common mercury take an amalgam of gold; besides

Arguments
against transmu-
tation, from the
impostures in it.

besides many other methods which impostors have contriv'd, and which are rehears'd by *Crugnerus*^a, *Kircher*^b and *Michael Mejerus*, who in his *examen* of chemical cheats, describes above 29 other impostures^c.

From the disagreement among chemists.

Such as deny the transmutation alledge the great disagreement among chemists themselves about its proper matter, while some search for it in sulphur; others in vitriol; others in mercury, fixt in a mass of alum; others in arsenic; others in an uncommon mercury, such as the returning sun in the month of *March* diffuses every where, and which is to be gather'd ripe in the month of *October*^d; and some even in cheaper materials: Hence *Kircher*^e would chuse the mean way, and neither assert the impossibility of transmutation, nor even that it is perform'd in the manner alchemists suppose, so as to be genuine and much more noble and pure than the natural gold; and he rejects that operation of the stone, which consists in calcination, in the separation, conjunction, putrefaction, coagulation, cibation, sublimation, fermentation, circulation, and in fine, projection of the four elements: But against this opinion of *Kircher*, *Solomon de Blawenstein*^f, as also *Valerianus Bonvicinus*^g have written with great acrimony. But *Zwölffer*^h opposes *Kircher* with greater moderation. Many on the contrary assert the transmutation as a certainty; and they attempt to teach its preparation. *Job. Dan. Mylius*ⁱ gives us a catalogue of them from the *Arabs*, *Greeks*, *Spaniards*, *French*, *Italians*, *English* and *Germans*. And *P. Borellus*^k enumerates their writings.

The facts that favour transmutation.

It is not my design to set up for umpire in this dispute, nor do I adduce the testimonies of past ages and the instances of *Raymond Lully*, *Arnoldus de Villanova*, *Paracelsus*, *Sendivogius*, *Anton. Bragadinus*, a *Venetian*, *Trevisanus*, *Turnbeiserus* and others, who are said to have made chemical gold; seeing in our curious age some very certain experiments were made, outweighing the reasons adduced to the contrary; and the presenting these to the reader, may, it is hop'd, be acceptable, as they are taken from authentic accounts.

Dan. Sennertus^l says that the other metals may be reduced into gold, a thing that has been often prov'd in our days; and what *Alexander Seaton*, a *Scotsman*, has done at *Cologne*, *Basle* and other places, is very well known; on which head may be seen the history of the transmutation of metals by *Ewaldus de Hogelande*, and the writings of *Andr. Libavius*, which he publish'd in defence of the art of transmutation.

To derogate from the testimonies of so many excellent persons, says *Cornelius Martinus*^m, of *Antwerp*, who in their writings solemnly affirm, that

^a *Informator chymicus*, p. 53.
factorum pseudochymicor. p. 32. 37.

^b *Mund. subter.* lib. ii. sect. 2. f. 281.

^c *Examen*

^d *Fons chymicus philos.* p. 90.

^e *Mund. subter.*

lib. ii. f. 2. c. 1. f. 250.

^f *In interpellatione brevi ad philosophos contra alchymisticum.*

Mund. subterran. apud Bernates, 1667, edita.

^g *In lance pripatetica.*

^h *Mantiss.*

Spagyr. part 1. cap. 1. f. 324.

ⁱ *Tractat. iii. Basil. chym. præf.* l. 1.

^k *Bibliothec.*

chymie, Paris 1654 Edit. 12.

^l *Nat. scientiæ.* lib. 5. cap. 1.

^m *Analys. Logic.* cap. 8.

that they had seen with their very eyes, and not only felt with their hands, but that they had accomplish'd the transmutation of one metal into another, would seem to be acting the part of an imprudent person, and not that of a philosopher. When in a public disputation this *Cornelius Martinus* refuted by many arguments the notion of the stone, a certain nobleman standing up in the company, order'd coals and lead to be brought him; and in the presence of *Martinus* and others, throwing a certain tincture into the fus'd metal, by means of it he transmuted the melted lead into gold; and upon this *Martinus* recanted his former opinionⁿ.

Job. Baptista Van Helmont^o confesses of himself; 'I am obliged to believe the stone that makes gold and silver, because at different times with my own hand I made the projection of one grain, I think, upon some thousand grains of hot quicksilver; and to the admiration of many who were present, the business succeeded in the fire, as books do promise. That stranger who gave me the gold (for he gave me about half a grain, with which I transmuted nine ounces and three quarters of quicksilver) had at least so much of it, as was sufficient to transmute 200,000 pounds into gold.' He confirms the same thing in his treatise *de vitâ æternâ*^{*} towards the end; and more fully in his treatise, entitul'd *Demonstratur thesis*^p.

In 1648, one grain was sent to *Prague* to the Emperor *Ferdinand III.* with which three pounds of mercury were converted into gold^a. The story is more accurately told thus by others; the nobleman, who in the presence of his Imperial Majesty reduced with one grain of the powder, mercury into gold, was call'd *Richthausen*, and whom the Emperor made a Baron, with the title of *De Chaos*. From this transmuted gold his Imperial Majesty order'd to strike a medal with particular inscriptions on each side; on one side, the figure of a naked young man, with a sun instead of a head, and in his right hand lifted up holding *Apollo's* lyre; and in his left hand hanging down, *Mercury's* caduceus, with this device, *divina metamorphosis exhibita Pragæ xv Jan. 1648, in præf. S. Cæs. Maj. Ferdin. III.* On the reverse, *raris hæc ut hominibus nota est ars, ita rarò in lucem prodit. Laudetur Deus in æternum, qui partem infinitæ suæ scientiæ abjectissimis suis creaturis communicat.* This medal, afterwards found in the Emperor's scrutore, was by the Emperor *Leopold* given to *Zwölffer* to be struck and grav'd in brass, as *Zwölffer* himself testifies in his *Mantissa pharm. Spagyr.*^r where we have a figure of it, as also in *Becher's Oedipus chymicus*^r. In what manner, and from whom this *De Chaos* had the powder, *Monconny* gives an account^t (as the Electoral Bishop of *Mentz* at the diet of *Ratisbon* in 1664 had informed him) whose words are to the following purpose; there

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ⁿ *Zwölff. Mantiss. Spagyr. f. 328. col. 2.* ^o *Traſtat. arbor. vit. p. 793.* ^{*} p. 743.
^p § 58. seq. p. m. 671. Edit. Amſtel. ^a *Harſdörffer in ſpeculo hiſtoric. hiſt. 80.* ^r f. 329.
^f p. 185. ^t *Voyag. Tom. II. p. 378.*

there liv'd one *La Busardiére* in the house of a certain nobleman (suppos'd to be the Count *de Schlick*) at *Prague*; this man, falling ill and at the point of death, writ to his acquaintance *De Caos*, and begg'd of him to come to *Prague*, as soon as possible; but the sick man died some hours before *De Caos* came, and after his arrival enquiring whether he had left any thing, the master of the household shews him a certain powder, entrusted to his care, tho' he did not know its use. This powder was carried off by stealth by *De Caos*, and with it he made several projections; the first of which was made in the presence of the late emperor, who caus'd strike a medal of this gold, on one side of which was the character of mercury, and on the reverse, the day and year it was struck.' This far *Monconnys*, who in the description of the medal which he had not seen, differs from *Zwölffer*, who was an eye-witness, and consequently is of greater credit in his account of it.

Besides, *Monconnys*^u was told at *Ratisbon* by Count *de Par*, chamberlain to the late emperor, that an unknown person had offer'd the emperor a little of a powder that remain'd at the bottom of a small box, which powder along with the box, being put on a fused mass of equal parts of mercury and silver, exhibited, without burning the box, so strong a tincture, that after that extraordinary red mass was broken and cut thro', it internally exhibited a great many red veins like blood, an indication that the powder was still too strong. After re-fusing that mass with the addition of new matter of the same weight as at first, all that was converted into gold was upwards of 24 carats in respect of colour. This person had receiv'd the powder from another, and therefore he knew not the secret of preparing it.

The same Count *de Par* told, that at another time a certain old man came to the emperor, and brought him a little of a certain powder, and begg'd that it might be tried, because he believ'd it would possibly be of some use. The emperor orders, that he should return within three days; and upon trying the powder, eight ounces of mercury were converted into perfect gold: Upon which the emperor order'd to bring the man, but by this time he was gone, and never after seen^w.

Strobelberger, an apothecary at *Ratisbon*, told *Monconnys* how a certain merchant of *Lubeck*, (who but little applied himself to merchandising, but was master of the art of fixing and converting lead into gold) gave *Gustavus Adolphus*, king of *Sweden*, a mass of gold of 100 pound weight, of which the king order'd to coin ducats; and to distinguish them, on one side was the king's effigies, and on the reverse, the royal arms, with the chemical characters of sulphur and mercury on each side: And from the above-mention'd apothecary *Monconnys* had one of the pieces. The merchant after his death, tho' for many years before he had given over trade, and tho' he

^u Ibid. p. 371.

^w Moncon. *Voyag.* Tom. II. p. 371.

he was never successful in it, left an estate of 17,000,000 crowns*. I myself had a present made me of one of these ducats by *Ludovicus de Schonleben*, and mark'd with the characters of sulphur and mercury, of which I have given a figure, as also of that other of the bishop of *Mentz*; that not only the truth of what was said might appear, but that if the like coin should happen to fall into the hands of others, they might be able to distinguish them. Fig. 2. Plate III.

Georgius Fredericus de Greiffenclau, archbishop of *Mentz*, order'd to coin ducats from mercury converted into gold, and they are mark'd with the character of mercury, as in the figure, and such a one I have in my museum.

Besides the projection, made by *De Caos* in the presence of the emperor, he perform'd another before the great vicar of *Mentz* and the archbishop himself; and this, as the elector himself told *Monconys*, he effected with all the precautions which philosophers usually employ in such an operation: He took a small pill like a lentil, prepar'd from that powder with gum tragacanth, that uniting together they might the better cohere, he roll'd up this pill in wax, which he put into the bottom of the crucible, and laid upon it four ounces of mercury, and put it into a fire of suppression. After a strong blast-heat for half an hour, upon removing the coals, the gold was seen fus'd, yet with very red rays, which are otherwise commonly green. He, therefore, thought that the gold was still too generous; and that, therefore, it was necessary to take it down by the addition of silver. The elector himself threw in some bits of silver; and after a perfect fusion, when it was pour'd into the ingot, there was a beautiful mass of gold, but which was found somewhat acrid, the cause of which *De Caos* ascrib'd to the smell of brass, which happen'd to be found in the ingot, that, therefore, it was very proper to send it to the mint to be run, after which it was very beautiful and sweet; and the warden of the mint affirm'd, that he never saw a more beautiful piece, that it was above 24 carats; and what is greatly to be admir'd is, how that acidity could be taken off by one single fusion; and the elector promis'd *Monconys* a bit of this gold^y. *Becher* in his *Oedipus Chymicus*^z does also confirm this very thing; 'the same person, says he, who gave the tincture to the emperor *Ferdinand*, repeated the same thing ten years ago at *Mentz*, in the presence of the elector and other great personages, in a pretty large quantity: And this the warden of the mint there, who coin'd ducats of this gold, can testify.'

The same elector affirm'd, that with one grain of powder he had seen three marks of gold made from two pounds of mercury; and that, upon taking them out of the crucible, as they were too high colour'd, by the addition of three or four drachms of silver they were all converted into gold^a.

* Id. *ibid.* p. 381.
Tom. II. p. 372.

^y *Ibid.* p. 378.

^z *Tit.* 7. §. 6. p. 186.

^a *Moncon. Voyag.*

In what manner an unknown person, meanly dress'd, and pretending to be born in the north of *Holland*, came *December 27, 1666*, to *Joh. Frederic Helvetius's* house at the *Hague*, and gave him a bit of powder, as big as a rape-feed; with which, roll'd up in wax and thrown into six drachms of melted lead, the lead was transmuted into gold, the same *Helvetius* relates in a treatise, entitul'd *Vitulus Aureus* ^b. This gold, put into the hands of *Borelius*, general assayer of the mint in *Holland*, and examin'd by quartation, was found so extraordinary, that it still transmuted some part of the silver thrown into the gold in the assay.

The honourable Mr. *Murray*, in a letter to *Monconnyse*, dated *August 17, 1664*, likewise testifies that prince *Rupert* had it from the present elector of *Mentz*, that the projection of gold was successfully perform'd in his presence; and that the same prince *Rupert* had, in *1662*, given to king *Charles* a large piece of gold, made at *Innsbruck* by the same person, who gave the powder to the elector; and this story Mr. *Murray* mention'd in the presence of *Monconnyse*, as also the assay he had made of the gold by the king's orders.

The grand principle of Optics, Catoptrics, and Dioptrics. By G. G. L. From the Acta Eruditorum An. 1682. p. 185.

Translated from the LATIN.

The common principle of optics, catoptrics, and dioptrics.

THE primary hypothesis, common to these sciences, and from which every direction of the rays of light is geometrically determin'd, may be this; light comes from the radiant to the point to be enlightned in the easiest way possible; which way is in the first place to be determin'd with respect to plain surfaces, but it is accommodated either to concave or convex surfaces, taking in the consideration of their plain tangents: Yet I have here no regard to some irregularities, which probably take place in the generation of colours and in other extraordinary *phenomena*, which in optical practice are not regarded.

The way of a direct ray.
Fig. 3. Plate III.

Hence in simple optics the direct ray comes in the shortest direct way from the radiant C, to the point to be enlightned E; namely, the medium remaining the same, that is, in the right line CE.

The angle of incidence equal to that of reflexion.

In catoptrics the angle of incidence CEA, and of reflexion DEB, are equal: For, let C be the radiant, D the point to be enlightned, and AB a plain speculum, the point E of the speculum reflecting the ray to D is sought; I say it is such, that the whole way CE + ED is the shortest of all, or shorter than CF + FD, if, to wit, any other point F of the speculum were taken: This shall be obtain'd, if E be taken so, that the angle CEA and DEB are

^b Cap. 3. p. 26, seq.

^c Moncon. Voyag. Tom. II. p. 70.

are equal, as is plain from geometry. *Ptolemy*, and others of the ancients, have employ'd this demonstration; and it is extant both in *Heliodorus Larissæus* and other authors.

In dioptrics, the sines of the complement EH and EL of the angles of incidence CEA and of refraction $GE B$ have always the same ratio, which is reciprocal to the resistance of the medium's. Let IE be air, EK water, or glass, or any other medium denser than air, the radiant in air C , the radiand under water G ; the way of the ray is sought, or that E be the point in the surface of the water AB that refracts the ray coming from C to G , this point E should be so taken as to be the easiest way possible: Now in different medium's the difficulties of the way are in the compound ratio of the length of the ways, and of the resistance of the medium's. Let the right lines m and n represent the resistance with respect to light, the former that of air, and the latter that of water; the difficulty of the way from C to E will be as the rectangle under CE and m ; from E to G , as the rectangle under EG and n : Therefore, that the difficulty in the way CEG may be the least possible, the sum of the rectangles $CE \times m + EG \times n$ should be the least possible, or less than $CF \times m + FG \times n$; assuming any other point F besides E , E is sought: Since therefore the points C and G , as also the right line AB are given in position; we shall, therefore, call the right lines perpendicular to the plane CH , c ; and GL , g ; and HL , which is also given, b : But EH , which is sought, we shall call y ; and EL will be $b - y$, and CE the $\sqrt{cc + yy}$, which we shall call p , and EG will be the $\sqrt{gg + yy - 2by + bb}$, which we shall call q : $m \sqrt{cc + yy} + n \sqrt{gg + yy - 2by + bb}$, (or $mp + nq$) should, therefore, be the least quantity possible; and that it may be such, y is sought. By my method *de maximis & minimis*, which, above all others hitherto known, surprisngly contracts the calculus, at first sight, and almost without any calculation, it appears, that $m q y$ will be equal to $n p$; $b - y$, or $n p$ to $m q$, as y to $b - y$, or the rectangle $CE \times n$ to the rectangle $EG \times m$, as EH to EL : Therefore, supposing CE and EG equal, n the resistance of the water in respect of light will be to m the resistance of air, as EH the sine of the complement of the angle of incidence CEA in air, to EL , the sine of the complement of the angle of refraction $GE B$ in water, or the sines of the complements will be in the reciprocal ratio of the resistance of the medium's, which was the thing asserted: If, therefore, EL in one instance, or experiment, be found to be $\frac{2}{3}$ of EH , it will be also in all others, wherever C and G are taken, the former in air, the latter in glass; if E be in air and G under water, EL will be $\frac{3}{4}$ of EH nearly.

We have, therefore, reduc'd all the laws of rays, verified by experience, to pure geometry and calculation; by employing one principle only, taken from the final cause, if you rightly consider the matter: For, neither does the ray proceeding from C consider, how it may in the easiest manner arrive

The co-sines of the angles of incidence proportional to those of refraction.

The principle mention'd above deduced from final causes.

arrive to the points E, D, or G; nor is it of itself referr'd to them; but the Creator of the universe has so form'd light, that from its nature that beautiful *phenomenon* should arise: They, therefore, greatly err, to use no harsher expression, who with *Des Cartes* reject final causes in physics; seeing besides the occasion of admiring the divine wisdom, these causes likewise furnish us with a very beautiful principle for finding the properties of those things, whose more intimate nature is not hitherto so clearly known to us; that we may be able to use the proximate efficient causes, and to explain that machinery the Creator has employ'd to produce those effects, and to obtain his ends: We hence also understand, that the thoughts of the ancients upon these things are not so despicable, as some moderns hold: But it seems probable to me, that these great geometricians, *Snellius* and *Fermat*, men very conversant in the geometry of the ancients, have transferr'd to dioptrics the method the ancients us'd in catoptrics; and indeed, I suspect, that *Snellius's* theorem, which *Isaac Vossius* adduces from his three books of optics, which were not publish'd, was discover'd by a method almost similar, tho' I think not with such ease of calculus, as I have here employ'd: But that it follows from my calculation, I shall thus shew: Let the circle CBG be describ'd from the centre E with the radius EC or EG, and let CE meet its tangent at B produc'd in V and EG in T; let the eye be in C, and the object which is seen under the water in T, and the point T will appear to be in V; because we seem to see it along the right line CEV: Yet since we really see it by the broken line CET, it is plain that EV is the secant of the angle of incidence CEA, or its equal VEB; and that ET is the secant of the angle of refraction GEB; but, from a known proposition in trigonometry, the secants are reciprocally as the sines of the complement; therefore, directly EV is to ET as EL to EH, or (by our *theorem*) as *m* to *n*: The eye C, therefore being in a different medium than the object T, the apparent ray EV in the medium of the object (water) to the true ray ET in the same medium of the object (water) as *m*, the resistance of the air, the medium of the eye, to *n*, the resistance of water, the medium of the object; which ratio, as it is always the same, the medium's remaining the same, the ratio, therefore, between the true ray ET and the apparent ray EV will be always the same, which was *Snellius's* theorem.

Fig. 3. Plate III.

The reason why the co-sines of the angles of refraction and incidence are proportional not well explain'd by *Des Cartes*.

In the same manner seeing the ratio of EL and EH, the co-sines of the angles of refraction and incidence, is, according to us, reciprocal to the resistance of the medium's; it will always be the same, which is *Des Cartes* theorem; tho' his opinion about the resistance of medium's be different from, nay contrary to mine: Wherefore, not without reason, does *Spleiffius*, a man very conversant in these studies, upon observing this coincidence of conclusions, doubt whether *Des Cartes*, when in *Holland*, had not seen *Snellius's* theorem; for, he observes that it was a common thing

thing with him to omit the names of authors, and he gives his *vortices* as an instance, at which *Jordanus Brunus* and *Job. Kepler* had hinted in such a manner, that they seem to have only wanted that term: Add to this, that *Des Cartes* setting about to demonstrate this theorem by his own skill, fell into great difficulties: For, because he saw that the ray *CE*, carried from air into water, is there refracted in *EG*, and thus towards the perpendicular *EK*, and therefore, render'd more similar to that ray (whose action is stronger) namely the perpendicular ray, he suspected that it met with less resistance in water, or glass, than in air: Whereas supposing the contrary, which is much more agreeable to reason, and employing our principle of the easiest way, we may arrive at the same conclusion. Whence *Fermat* rightly gather'd, that *Des Cartes* had not given the true reason of his theorem; and likewise the comparison, by which he endeavours to illustrate his explication, is but little to the purpose. Let the ball *A*, running on a smooth table *BC*, in the place *1A* meet in the middle of its course part of the table *DE*, cover'd with tapestry, when it will run slower in *2A*: In the same manner, therefore, he thinks, that glass, or any other solid body, less hinders the rays of light than air, which is not so smooth; but (not to mention that the parts of water are sufficiently yielding, according to *Des Cartes* himself) it is sufficient to consider that the ball, when it comes from *2A*, after having pass'd over the tapestry *DE*, again comes to a smooth part of the table in *3A*, and cannot there recover its former celerity, which it had in *1A*, before it met the tapestry; yet since the ray of light does again enter from a greater resisting medium into a less resisting medium similar to the first, and recovers its former state; and supposing that the surfaces of two similar medium's, to wit, the first and the last, be parallel planes, it may receive a direction by the latter refraction, parallel to that which it had before the former refraction.

Fig. 4. Plate III.

Yet the manner in which *Des Cartes* explains both reflexion and refraction of light, in imitation of the motion of other bodies, seems to be worthy of his genius, and not to be rejected but only amended: For, as to reflexion, he should have in the first place explain'd, why any ball as *I*, falling along the perpendicular *IE* on the plane *AB* is from thence reflected: For, we observe that some bodies, namely such as are soft, are not equally reflected, the true cause of which reflexion is the elasticity either of the ball or plane, or both; for, an elastic plane will yield a small matter, as we observe a stretch'd membrane or inflated bladder do to a falling pebble; and indeed, it will yield so much the more as the stroke is stronger; and restoring itself with so much the greater force, it reflects the impinging body towards the same parts, and with the celerity it came: For, tho' *Des Cartes* could not bear this explication of reflexion, advanc'd by some of his contemporaries, as appears from his letters, yet at this day

Des Cartes manner of explaining refraction and reflexion not to be rejected but amended.
Fig. 3. Plate III.

Fig. 3. Plate III.

it is verified both by reason and by experiments. Since, therefore, the ball comes from C to E in the right line CE, and consequently with a motion, compounded of two others, to wit, the horizontal, as CI or HE, by which it comes from CH to IE, and the perpendicular as CH or IE, by which it comes from CI to HE, both beginning at C and terminating in E: And as the surface AB does not oppose but is parallel to its horizontal *conatus*, coming into E from CH towards IE in the right line CI or HE; it will, therefore, retain unchang'd both the celerity and direction of its horizontal motion; and the same space of time it spent in coming from CH to IE, it will likewise spend in coming from EI to RD, supposing the intervals between CH and IE, as also between IE and RD to be equal: But the perpendicular motion, whereby it came from CI to HE, retaining its velocity, will be chang'd into the contrary direction, that it may spend as much time in which it may return from ER to ID; since therefore ER is equal to EH, and RD equal to CH, the triangles CHE and DRE will be similar and equal; and consequently, the angle DEB will be equal to the angle CEA. All this will be more manifest, if we suppose the ruler CID parallel to the surface AB, and retaining its parallelism thro' CH and DR to impinge on AB in HR, while in the mean time a ball in the ruler CI is carried from C to I: Whence in reality the whole compound motion of the ball will be in the diagonal CE; but the ruler CID reflected by the solid surface AB will return with the same celerity, and by the same way it came, and in an equal time will again come to CID; while in the mean time the ball continuing its motion in the ruler, has advanced with the same celerity; and therefore, in the same time arrives from I to D thro' ID = to CI: For, the celerity remaining the same, equal spaces are run over in equal times: The ball, therefore, with a motion compounded of its own motion upon the ruler thro' ID and that of the ruler along EI, to wit, returning from HR to CD, will be carried from E to D along the right line ED.

Refraction how
explain'd.

In order to explain refraction, we are to consider that the greater resisting medium to light (yet without opacity) seems to be that which more hinders the diffusion or distribution of light thro' more parts of the medium; and it may be call'd less illuminable: For, the nature of light endeavours to diffuse itself. On the contrary, by how much more the light equably affects the parts of the medium it illuminates, or communicates its force to a greater number of insensible particles of the illuminated place, the medium will be the more illuminable, and less resist light: Whence the more solid and small the parts of the medium affected by light are, or the less space they leave between them for another heterogeneous matter, not affected by light, the medium will be said to be the more illuminated: But it appears from mechanical principles, that the same stroke, impress'd on several bodies at the same time, communicates a less

less force to each than if the stroke had been given to one of them: It will, therefore, happen that in a medium which more resists the diffusion of light, or which is affected in a less number of its parts, each part is so much the more strongly affected; in a more illuminable medium more parts are affected, but weaker and with a more languid impress'd stroke: Assuming now the motion of the ball instead of the ray, and supposing the ball coming from G to E, there to impinge on a medium, which shall retard its celerity or *impetus* in a sesquialteral ratio, suppose: If, therefore, in a minute of time it comes from G to E in the former medium KE; in the new medium EI the same ball will come from E to C in a minute and a half, supposing EC and GE to be equal in whatever point C is. But since the surface AB that separates the medium's shall not oppose the horizontal celerity in GK, LE and the parallels thereof upon the balls first entering into the new medium EI, or in the very point E (for, the horizontal motion LEH only grazes along the separating surface AB) but in the first moment of its entering or in the point E (considering the ball as indefinitely small like a point, as rays themselves are usually consider'd without breadth) the inclination of the line CE is to be presently determin'd: It is, therefore, to be taken at the very first; so that, in respect of the horizontal motion, the velocity may remain the same, and such as it was assum'd at the beginning of its ingress into the new medium, such it remains therein: The ball, therefore, while it went in the former medium from G to E, had absolv'd in a minute of time with the horizontal direction, the interval GK or LE (between GL and KE) it now in a minute and a half of time, in which it should move from E to C, will accomplish in the same horizontal direction the interval EH or IC, (comprehended between EI and HC,) which ought to be sesquialteral of the former LE; because the horizontal velocity remaining the same, which is not changed by refraction, the spaces are as the times: EH, therefore, is to EL in the direct ratio of the times, or the reciprocal ratio of the celerities or resistences; for, we have shewn in the case of the light, whose diffusion is impeded by the resistence of the medium, that the velocity or *impetus* increases according to the resistence, and languishes according to the greater facility of diffusing itself in each part. On the contrary, that the ray recovers its force, and consequently, its direction, when again it comes into a medium where there is a less diffusion, and more rays are employ'd in impelling a fewer number of parts; and this recovery *Des Cartes*, as we mention'd above, could not explain by his comparison of the tapestry, or any other rough body.

Of the Iron-works at Malmitz near Sagan in the Principality of Glogau in Silesia. From the Breslaw Collection, September 1717. Class IV. Art. III. p. 61.

Translated from the HIGH-DUTCH.

Instances of the growth of iron-ore.

THE preparing iron from the stone at *Malmitz* is indeed no new work: But as not long since a fistulous ore of iron was observ'd among it, such as some time before was also found at *Lausnitz*, and according to *Aldrovandus* in his *Musæum metallicum* at *Sagan*; where ore is dug, and the grooves afterwards fill'd up with earth, in ten years, good ore may again be found therein; and as *Stavisl. Rein. Acxtelmeier*^a relates of the island *Elba*, near *Florence*, that in like manner iron grows there; so that in ten years, there is again as much iron as was at first taken out.

Description of a fistulous ore.

This fistulous ore of iron is of a yellow brown cast, pretty hard, and a finger thick, and long more or less, and of such a form as *Aldrovandus* in his *Musæum metallicum*^b represents, and calls *stalaetites fistulosa*: But whether our ore may be thus denominated, can remain no doubt, as it also runs from a trunk into branches; and like the *osteocolla* of *Massaw*, or the arborefcnt fossil found there in the sand^c, it also runs into the drain'd iron-stone, and may be likewise had in entire pieces, if the brittleness of the ore, before it is harden'd by the air, do not hinder, or rather if it is not spoil'd by the heedlessness of the workmen: And mixt in small pieces, along with the common iron-stone, and committed to the furnace, it gives good iron, only that on account of its stubbornness it is somewhat hard to run.

Testimonies about the growth of this ore.

Aldrovandus undoubtedly borrow'd the remark about the growth of iron from an author alledged by *Hennelius*^d, who speaks to the following purpose; 'George Agricola, a man conversant in metals, and greatly skill'd in metallurgy, and of extraordinary diligence and learning, expressly asserts it': And *Jodocus Willichius* on *Tacitus's Germania*, as also *Petrus Albinus* in his *Chronicon Misniæ metallicum*^e, testify the same thing; and *Georgius Fabricius*^f relates, that iron dug up in *Silesia* is supplied by a new increase; and that the earth and the trunks of trees do in that increase acquire the matter of iron, at the first, like a kind of thick liquor, which is afterwards more and more hardened'. And this *Hennelius* himself must have believ'd, since a little before he writes; 'the iron which is dug up out of the meadows of *Silesia* near *Sagan*, is again in ten years supplied by a new growth, and again dug up; in the same manner, as the

^a *Idea harmon. correspond.* p. 199.

^b *Lib.* 1. p. 143

^c Vide *Leon. Dav. Hermannii Mafsiographia*, part 2. cap. 11. p. 182. lin. 188.

^d *Silesiographia renovata* cap. 3. p. 340. Ed. Vratisl. 1704. quarto.

^e *De Veter. & nov. Metallis*, lib. 2. cap. 15.

^f *Tit.* 7.

^g *Obs. Metal.* cap. 8.

‘ the iron of the island *Elba*, the lead of the *Monte Fesulano*, and the
‘ copper near *Apollonia* in *Dalmatia*: So that there is always a constant
‘ supply of iron.’ The account we had of this *Malmitz* ore is as follows:
‘ the grooves, out of which the ore is dug, are again fill’d up; but that
‘ earth yields no iron-stone, it is rather the subtile irony substance, which
‘ along with the sand is wash’d from the ore and passes through the sieve,
‘ that yields the stone; this irony matter successively begins to rust, so
‘ that in five or six years they may there dig again; yet the matter
‘ is not so good as what has been a growing for several years together:
‘ And it is also easy to conclude, that it is not so tractable as the old stone;
‘ much less yield such a quantity as the old *Malmitz* ore, which is reckon’d
‘ the best of all.’ Now as in this manner the generation of this stone is,
according to the above-mention’d authors, not sufficiently confirm’d
by the above account, it is very possible, that the above describ’d fistulous
ore was at one time or other taken for trees and branches of trees; tho’
we are not also ignorant of what some authors have maintain’d about the
truth of this mutation, and that not without some grounds^h.

The place where this iron-stone is found in greatest plenty is in the terri-
tory of *Malmitz*, which lies in the principality of *Glogau*, a mile from
Sprottau, and two miles from *Sagan*: the country is very marshy and
deep, with alders, wild pine and birch trees up and down; and the mine
itself is two large miles in compass: They dig up the iron-stone imme-
diately under the green sod; and the only inconvenience is that the workmen
cannot go deep enough, on account of the water that pours in from above,
and the great number of springs: These springs yield a very fine water
for drinking, yet it has a strong mineral taste of the iron-stone: The
cattle hereabouts, which drink of it, receive not the least harm by it:
The corn in a very dry season cannot thrive so well on account of the
hot mineral bottom; and when the season is too wet, it suffers as usually
in other fields: The trees, which, as was mention’d above, grow here of
various kinds, tho’ they strike deep root in this iron-stone, are not in the
least hurt by it.

An account of
the place where
it grows.

Of this iron-stone the ponderous is the best, and in particular the
entirely light-blue, which appears like smalt, and is pretty tender: There
are also pieces found among it, as hard as a *pyrites*, but of little use, except
for yielding a flux in the smelting. This stone dug in the pit is pass’d
thro’ a sieve, brought into a heap, measur’d, and from thence carried
to the iron-cinder, in an open place behind the forge: As much of the
stone, as they design to use, is brought to the smelting-house, and laid
on gradually, after first mixing lime with it, that it may thereby give a
light and good body, and that the iron may obtain its proper temper;
the smelting is perform’d in the following manner. They

What sort of iron
stone here is best,
and how prepar’d
for smelting.

^h Vide Joh. Georg. Liebknecht *discursus de deluvio maxim. occasione inventi nuper in
comitatu Laubacensi & ex mira metamorphosi in mineram ferri mutati ligni.*

The furnace
where the iron
ore is run.

They first make a platform shelving against a brick wall, over which a wide flew is built, and behind which the bellows hang, but under these is a trench for letting out the *scoria* or *slag*: This shelving part has a pit in the middle, and over this they hang the nose of the bellows in such sort, that the ore shall not be exposed to too strong a blast; into this pit are shot coals, and over these, layers of coals and iron-stone, and fire set to them, and coals shot in till the stone run; and in five or six hours after they shoot in coals and iron-stone gradually, till the pit below is pretty full of the smelted stuff; and then the iron lies as a spongy unfluxile mass at the bottom, after first removing the coals from the top of it, and the air has access to it, and it is heav'd a little up, that the *scoria* standing on it may run off thro' the tap-hole into the trench under the bellows, the remaining mass is heav'd out with levers, and roll'd to the forge, which is hard by; where with a strong swing it is laid on the anvil under the hammer, which being untrigg'd, it is beat so long till it becomes a flat round piece, as large as an ordinary hat, and an hand-breadth thick; by the first blows the mass is not only wedged close together, but it is made plentifully to discharge the *scoria* still remaining in it; and in this case the workmen must be very cautious they are not burnt by it. This flat piece is afterwards cut into long pieces by means of the same hammer, and put into a smith's forge, which is hard by, and compleatly divided and hammer'd into plates. They sometimes also pour water upon it to make it smooth and glossy; and lastly the mark of the place is struck on it, and it is weighed and expos'd to sale.

The quantity of
stone work'd in a
year uncertain.

The quantity workt in a year cannot so properly be ascertain'd: For, the seasons are not alike, sometimes there is a hard winter, sometimes a great deal of water; and again too little water: So that many times for some weeks together, and in very long hard winters they cannot work a quarter of a year. The quantity of iron-stone properly requisite to one cake or pig is not always the same: For, according as the stone is prepar'd, more or less of it is us'd; but when the stone is pure and good, to one pig they use 18 buddled quarters, *Breslaw* measure, from which they obtain about two centners of pure iron. It is sent to the principality of *Glogau* and *Sagan*, as also to *Poland* and *Saxony*, where it sells well, as of this kind of iron it is found to be the toughest.

Of the Mermaid, &c. By Thomas Bartholin. From the Miscellanea Naturæ Curiosorum. An. 1. Dec. 1. Obs. 23. p. 85.

Translated from the LATIN.

A mermaid seen
in the harbour of
Copenhagen.

THERE was a report of a mermaid appearing near the harbour of *Copenhagen* in the summer of 1669: And there were a great many spectators on our shore, who faithfully related what they had seen; yet they differ'd

iffer'd as to the colour of the hair; some asserting it to be red, others black: They all confirm'd that she had a human face without a beard, but a forked tail, which is different from that whose dissection I have given in my *historiæ rariores*, some of whose bones I still keep: For, the tail of this consisted of an unform'd mass of flesh, as I have there represented it^a, unless we should take it for a distinction of sex or age: But it is of the sea-calf kind. The apparent difference of the hair probably depends on the different situation of the body, and the different incidence of the solar rays.

As the extent of water and sea, in respect of the earth, was so vast and capacious, the number of the inhabitants of the sea must likewise have been in proportion, and the species of fishes themselves have been much more numerous than those of birds or terrestrial animals; on which account water animals must have a variety of forms, and likewise a resemblance to other things: Whence we see that sea-animals even resemble celestial things, as there are fishes call'd from their resemblance *Luna* and *Stellæ*. In the ocean at the Equator there are flying fishes, who skim the air and make their way to ships: There are sea-hawks and sea-swallows: In the sea there are likewise innumerable species of trees and shrubs, and fishes that take their denomination from plants, as *urticæ* and *pastinacæ*: There are others resembling artificial things, as wheels, swords, saws, needles, &c. There are also in the waters, animals analogous to lions, cows, horses, dogs, rhinoceros, wolves, oxen, and calves: And why should we doubt, that animals resembling men may not be found therein; since so many eye-witnesses concur in this: For, if on land there are animals produced expressing the external form and gestures of men, tho' destitute of perfect reason; as is plain in monkeys and wild men, mention'd in curious relations; and if there is such a creature as the *ourang outang* from *Angola*, which was made a present to *Frederic Henry*, prince of *Orange*, and describ'd and delineated by *Tulpius*^b; and likewise a wild woman, covering her face with her hands, shedding tears plentifully, sighing and expressing other human actions, except speech, and describ'd by *Jacob. Bontius*^c, why might not the ocean, the fruitful parent of prodigies, produce such like sea-animals; and which, for the most part, are comprehended under the sea-calf kind?

The great number and variety of sea animals.

The ancients call'd these pisciform men, *Tritons*^d. Among the moderns *Alexander ab Alexander*^e mentions a *Triton*, seen in *Spain* and *Epire*: And *Schottus*, in his *Physica Curiosâ*^f, makes mention of many others from different authors^g. *Gesnerus*^h also describes a merman, which he calls a sea-monk, because of the resemblance, and also another, with a bishop's mitre;

Fishes resembling men call'd Tritons, and the reality of their existence.

^a Cent. 2. hist. 11. ^b Lib. 3. obs. 56. p. 275. ^c Lib. 5. histor. Indor. medic. cap. 32.
^d Plin. lib. 9. Pausan. lib. 9. ^e Lib. 3. Gen. D. cap. 8. ^f Lib. 3. cap. 3. § 362, seq.
^g Majol. dier. canic. colloq. 9. p. 349. Nierenberg lib. 5. hist. nat. cap. 14. Scalig. Exerc. 226. § 12.
^h Hist. animal. marin. ord. 12. de cetis f. 174.

mitre ; yet authors differ in their description of them, while some make them end in fish-tails ; and others give them human feet : And such was that merman, who perfectly resembled a man, with feet and a long beard, and in 1619 was seen walking on the sea by the counsellors of *Denmark*, on their return from *Norway* to *Copenhagen*, and carrying a bundle of grafs under his arm, but allur'd by a gammon of bacon, tied to a rope, he was dragg'd into the ship ; but when he spoke, and threaten'd to sink the ship unless he was let go, they again suffer'd him to jump into the sea, according to the relation of *Job. Philip Abelinus*ⁱ ; unless we should chuse to reckon him rather a *Demon* than a natural *Triton* ; because of his speech and predictions.

Fishes resembling
women call'd *Sirens*,
and that
there are really
such animal.

Such fishes of the female sex are call'd *Sirens* ; nor is the thing entirely fabulous, tho' their singing be so. Of the *Siren*, or mermaid, seen by *Theodorus Gaza* on the shore of the *Peloponnesus*, *Alexander ab Alexander*^k and *Schottus*^l make mention ; and this last distinguishes *Nereids* from *Sirens*, and reckons those of the number of *Nereids*, which have human feet, such as is that mention'd by *Johnston*^m. In 1403 in a lake in *Holland* was taken a mermaid, thrown in there by the sea, she suffer'd herself to be cloath'd, and would eat bread and milk, and learn'd to spin from the distaff ; yet she always continu'd mute : That mermaid which was taken in *Denmark*, and which, according to *Bartholin*ⁿ, could spin, speak, and foretell future events, is rather to be reckon'd a *Demon*. Other mermaids end in tails, and in their upper part either exactly resemble a woman or in part only : Of the first kind was that seen by *Capt. Smith* in *New-England* in 1614, which story is related by *Job. Lud. Godofredus*^o, and by *Georgius Stengelius* in his treatise *de Monstris*^p. This *Capt. Smith*, being scarce a pike length from the sea, espied a mermaid swimming towards him ; she was extremely handsome ; her eyes, nose, ears, cheeks, mouth, neck, forehead, in a word, all her countenance had the appearance of a very beautiful young woman ; her hair was of an azure colour, and flow'd down her shoulders ; all below the navel had the appearance of a fish : Yet there are mermaids represented in somewhat a different manner by some authors, and which differ but little in their upper parts from a woman. *Bartholin*^q relates from *Bernardinus Gennarus*^r, that in the vast river *Cuama*, near the cape of *Good Hope*, there are mermaids, which in their middle upper part resemble a human form with a round head, but immediately join'd to the *thorax* without a neck, and exactly like a woman in their ears, eyes, lips, and teeth ; and that upon pressing their breasts there runs out a milk. *Kircher*^s relates, that at certain times of the year such fishes of a human form are taken in the *East-India* sea : At the *Vassayas* and *Philippine* islands

ⁱ *Theatr. Europ. Tom. I. f. m. 321.* ^k *Lib. 3. Gen. D. cap. 8.* ^l *l. a. c. 4. p. 466.*
^m *Thaumatograph. class 10. cap. 5. § 9.* ⁿ *Cent. 2. hist. rar. 11. p. 187.* ^o *Hist. anti-*
podum part 1. f. m. 193. ^p *Cap. 2. § 8. p. m. 58.* ^q *l. a. p. 189.* ^r *Lit. 1. cap. 9.*
l. i. n. 1. ^s *Ars magnet. lib. 3. part. 6. cap. 2. § 6. Edit. Rom.*

islands according to the relation of *Didacus Bobadilla*, procurator of these islands; and that they are call'd *Pecche Muger*, and by the inhabitants *Duyon*; and he gives them a round head join'd to the trunk without any neck, that the nose differs from a human nose, that the other parts are like those of a woman, and the breast cover'd with a white skin; that their breasts are not flabby, but round like those of a young woman; that their arms are broad where-withal to swim, but without any fore-arms, hands, or joints.

To these things agree the *Triton*, whose skin in May 1647 *Monconny's* saw at *Torre*, a town and harbour on the *Red* sea, whose words are to the following purpose; 'these *Tritons*, says he, are large fishes as big as a camel, and taken in the *Red* sea; their head is like that of an ox, with a tail like a fish; the rest of the body from the belly upwards is like a man, or rather a woman (for, they are of both sexes) they have breasts, arms and hands like a man, only that their fingers are webb'd like a goose-foot, or a bat's wing, according to the relation of those who saw them; yet I afterwards saw a hand, but without the skin'. The same *Monconny's* saw in the same place the skin of a mermaid, which was ten foot long, and thicker than the hide of the largest buffle, and harder than wood, of which they make targets that are musket-ball proof, as also soles for shoes, which last three years.

In 1565 *Christophor Fürerus de Heimendorf* saw the skin of a mermaid at the same *Torre* hung up with its breasts and navel, the arms and head being cut off, and in its extreme part it resembled a fish. With this agrees the mermaid dissected by *Peter Paw*, professor at *Leyden*, and describ'd by *Bartholin*^w. At *Prague* in the Emperor's treasury was shewn the hand of a mermaid, and another hand at *Rome*, in *Corvini's* *Musæum*. *Kircher*, indeed, denies that this fish has a fore-arm and joints in its arms and hands: Yet *Monconny's*^x, together with *Bartholin*, allows that it has a *radius* and a *cubitus*, tho' very short, for the greater ease in swimming, and scarce four fingers breadth long, and that the compass of its shoulders is no wider. According to *Petrus Petrejus de Elefunda*^y, they are also found out of the sea in fresh rivers. On the other side of the province *Lucomoria*, says he, which is at the extreme confines of *Muscovy*, in the large river *Tachni*, the *Russians* relate, that there are fishes found there, which resemble a man in their head, eyes, nose, mouth, hands, feet, and other members, tho' they are destitute of speech and reason; and that they are very delicious to eat.

New

^t *Voyag Egypt.* Tom. I. p. 252.
hist. rar. 11.

^x *Voyag.* p. 189.

^y *Itiner. terr. Sanctæ.* p. m. 122.
Hist. Moscovit. p. m. 88.

^w *Cent.* 2.

New Rules for the conservation of Heat in Rooms. By Emanuel Suedenborg. *From the Acta Literaria Sueciæ. Trimestre Secundum.* An. 1722. p. 282.

Translated from the LATIN.

Rules to conserve heat in rooms.

IN northern countries heat is conserv'd in a quite different manner from what it is in those that are more southerly; and done by stoves, by help of which, the heat in charcoals and other coals, exhales and penetrates into the room, and so fills it; and of this you may have the benefit all day long. In other places the method is different: But I would incline to furnish rules, whereby heat may be conserv'd in such rooms, whose stoves consist of plates, &c.

Rooms built of wood warmer than those of stone.

1. Rooms, built of wood, are warmer than those built of stone; that is, walls made up of wood supply a greater heat than stone-walls do; the reason is, because stones continually exhale some degree of cold, which weakens the heat that approaches the walls: Whence the more stone there is in the walls of any room, the colder it is, but the more wood, the warmer. To prove this by experiments; put a large stone into the fire, and you will presently observe the fire lose much of its force; because the cold exhales from the stone: And thus near any stone you will feel it always cold: If you walk upon a stone pavement, in some time you will feel the soles of your feet cold, and afterwards the cold strike to your whole body; and if you sit upon a stone for a quarter of an hour, you will feel a great deal of cold: Lay a piece of ice either in the corner of the room, or under the table, and you will perceive a pretty intense degree of cold proceeding from it, and that at a good distance from the ice: And the quantity of this exhalation is proportional to the bigness of the piece of ice.

The more wood in a room, the more heat.

In like manner, the more wood there is in a room, the more heat it has; so that if the walls, tables, seats and other things be of wood, they neither diffuse heat nor cold: But upon the accession of the least degree of heat, there immediately and for some time after exhales an insensible heat.

Stone walls wainscotted, &c. warmer than if naked.

If stone-walls be wainscotted or hung with tapestry, there may be a greater degree of heat in the same room than if the walls were naked: For, wood and tapestry prevent the cold from exhaling too far from the stone, and from weakening the approaching heat: And hence by means of these, heat may be very much conserv'd.

As also plaster'd stone-walls.

And in like manner it is, if stone-walls be cover'd with a thick plaster: For, the plaster does not exhale so much cold as the naked stone: Whence it not only absorbs the cold, but likewise drives it back, that it shall not enter the room.

Walls,

Walls, made of common grey stone, emit more cold; and likewise the larger the stones are, or the thicker the walls, they emit so much the more, as we perceive in churches; but brick-walls emit less.

Brick-walls warmer than stone walls.

The more porous and light the stone is, the less cold it emits, and the easier it receives the heat, as *scoriae* of iron and calx's; so likewise the more porous wood is, and the more abounding in sulphur, the better it conserves the heat.

The more porous stone and wood is, the warmer.

2. The thinner stone-walls are, they contain and conserve heat in a room better than thick walls, which seems to contradict the principles of many: For, they imagine that the thicker the stone-wall is, the better the external cold is kept out from penetrating thro' chinks; but such people do not consider, that an intense cold exhales from the very stones, and the more so, the thicker the walls are: And again they can scarcely be warm'd in a long time. And experience likewise teaches, that in places where there has not been a fire for some time, the cold exhaling from the walls is felt for a long time. For further confirmation of this, let us suppose that the glass of the window, tho' it be very thin, be of the nature of stone; yet still no cold exhales from it, because it is thin. In like manner a piece of thinner ice has a less degree of cold than a thicker piece of ice: Whence if the walls consist only of one course of bricks, the room is render'd warmer than if it was built of the strongest stone.

The thinner stone-walls are, the warmer.

3. The less compass a wainscotted room takes, the warmer it is: Hence a square room is warmer than a round one; and an oblong room warmer than a square one, and the more oblong the better.

The warmth of rooms depends on their figure.

The greater space in the flooring and walls, that the fire burning in the stove can occupy with its rays or heat, the warmer the room is: Thus lower rooms are warmer than higher ones, both because the compass of the wall is but small, as because the heat does not ascend so high: For, the heat remains under the cielings; the contrary happens in rooms, which consist of naked stone-walls.

The more that rooms are expos'd to the heat of the fire, the warmer.

4. The upper parts of the house, the more close, compact, and the freer of chinks they are, the better is the heat conserv'd therein; the reason is, that the heat bursts out like a flood: But it is otherwise if the chinks be in the lower part of a room: For, the heat does not descend, but ascend: Whence no heat escapes through the lower parts, but the wind and the external cold enter there, and press and urge the heat in the upper parts to go out: Therefore, the rule is, the fewer chinks there are in the upper parts, or the more compact, the better.

The closer the upper part of the house, the warmer.

The farther a chink is from the roof, the less harm it does, and the less heat passes thro' it; but the nearer the roof, the more.

The heat escapes more at upper than lower chinks.

The higher the windows are, and the nearer they are to the roof, the heat is conserv'd with the greater difficulty, and *vice versa*. You will often find, that

The higher windows are, and the nearer to the roof the less heat they conserve.

that a wide and pretty large chink near a flooring, causes no waste of heat.

Directions in a wooden building.

Hence we are to mind ; 1. That the joining of the angles in wooden buildings be well executed, and mutually fit. 2. That the upper joinings at the roof be on every side close. 3. That the stove be very close, to wit, that the plates fit exactly to their places, without any gapings. 4. That there be no opening at the uppermost part of a window. 5. Nor in the upper part of a door. 6. Whence double windows and doors are best. 7. Doors which lead into any cellar or lower part of a house, draw a great deal of cold air, and cause a wind in the adjoining rooms.

How Vapours and other Bodies, which on Account of their Hottowness float in the Air, may be rais'd therein. By G. G. L. From the Miscellanea Berolinensia. Tom. I. p. 123.

Translated from the LATIN.

Vapours consist of bubbles of water and included air, and how rais'd.

1. **W**HY vapours are rais'd by heat is no inconsiderable question? And among other things, we do not improperly suppose in these vapours insensible bubbles consisting of a pellicle of water and included air; such as our senses show us in frothy liquors. And when a young man, I formerly made use of such kind of bubbles in a physical hypothesis in order to explain a great many things: Such a bubble, therefore, being given, but which may contain air rarer than the circumambient, it is possible, that the rarity of the included air may have greater force than the weight of the including pellicle of water: And therefore, that the entire bubble may be lighter than circumambient air of equal bulk, whereby the bubble, by the laws of hydrostatics, will ascend in the manner as a close vessel of iron full of air should ascend in water, if in proportion to its weight it have a sufficient capacity; nor is the elastic force of the ambient air of greater force in this case than the gravity of a column of air; because the elastic force in each part arises from the gravity of the column, and is equipollent thereto.

A two-fold force in air, the innate and adventitious.

2. But here there offers a great difficulty, namely that the circumambient air less rare than the included air seems by its elastic force, as if it would compress the bubble; and thus the included air will become of a density equal to that of the circumambient air: We are here, therefore, to observe, that there is a two-fold force in air, whereby it dilates itself, or preserves its dilatation; the one innate, the other adventitious. The former is what we call the elastic force, which exerts itself, not only when it is compress'd into a less compass than usual, as in wind-guns; but likewise in our common air, which we have learn'd, and that especially by the contrivance of the exhausted receiver, formerly discover'd by that excellent

excellent person *Otto Gueric*, that when press'd by the incumbent air, upon removing that pressure, it expands itself, if no other air be equally compress'd, or any other impediment hinder: For, flaccid bladders are spontaneously inflated in such a receiver, nay even in the free air, if they are carried from a valley to a high hill; because thus they are less compress'd.

3. The adventitious expansive force of the air, which supplies the place of its elasticity, is either heat or something else analogous to heat in fermentation, or the like natural operation. Thus it is possible, that the air included in the bubble and rarer than the circumambient air, may yet maintain itself and not suffer a compression from it, which is manifest to the eye by the experiment of thermometers; and the greater the heat is or any other force that internally dilates the air, the more will the aqueous pellicle be extended and become the thinner: But here a new question arises, namely, how such bubbles can be form'd, seeing the heat both of the included and circumambient air seems to be the same? I answer, that the included air shall acquire a greater degree of heat than that which even the particles of the external air have; because the circumambient air has both a greater and a different motion from the bubble: Whence new hot particles thereof continually flowing to the same bubble like a hot wind, communicate a new degree of heat to the pellicle, and thro' it to the included air by the continued contact of new air, as we feel that the hand grows either warmer or colder, if mov'd in hot or cold water, than if it was at rest therein: And it is the same thing, if the water be mov'd about the hand, and not the hand in the water; because many aqueous particles successively touch the same part of the hand, and communicate their quality thereto. From this principle it appears, that wine in a glass-bottle, swiftly mov'd up and down in cold water, or the water mov'd about the bottle, is the sooner cool'd.

What the adventitious force is.

4. Now if we understand the cause, why the bubbles of vapours ascend, it will be no difficult matter to explain why they fall down again: For, upon the heat gradually vanishing, the bubble will be compress'd by the circumambient air; so that the included air, upon the ceasing of the adventitious dilatation, shall return to a like density therewith, upon which the aqueous pellicle can neither ascend in the air nor support itself therein, no more than an iron-vessel can float or ascend in water, if it is fill'd therewith.

How vapours fall down again.

5. However, it is possible and it usually is so, that the vapours that are even ready to fall down, remain a little suspended in the air, in the same manner in which dust is sustain'd therein; because air, as all other fluids, has a certain degree of tenacity or cohesion of its parts; so as to require some degree of force, however small, to break thro' it, and which is proportional to the surface of the body which is to break thro' it: And because very small bodies have a small weight in proportion to their surface, yet notwithstanding their weight, they often remain suspended, and they

By a coalition of several bubbles

are:

are only toss'd up and down by the motion of the sustaining air: The same thing, therefore, happens to bubbles and very small drops; but if a great number of drops concur, which is done by that very tossing and motion, they coalesce into a larger one; and because the surfaces increase only as the squares, but the weights as the cubes of their diameters: Hence it is, that a bubble, or drop, by growing larger, acquires a sufficient force to fall down; and even the superior bubbles falling on the inferior ones, coalesce with them and become bigger.

How heavy bodies may be made to ascend and float in a specifically lighter liquor.

6. Besides, from the same geometrical reason the contrary arises, namely, that heavy bodies, reduced into the form of a vessel do, on account of the included *vacuum*, float or ascend in a liquor, tho' of a less specific gravity, as appears from an iron-vessel in water, and an aqueous pellicle in air. I remember some time ago at *Hanover*, that in the time of Duke *John Frederick* the people flock'd together, as if it were something miraculous, that iron should float in water: In the Duke's kitchen, situated on the river *Peina*, there was a large iron-pot fasten'd to a chain and in a great flood of this river, the water reach'd the pot and made it float up and down therein: For, from *Archimedes'* rule it appears, that if a vessel contain a weight of water greater than its own weight, it will float therein; but if still greater vessels be taken, the weights of the vessels increase nearly as the surfaces; but their capacities as the solidities, that is, the weights of the vessels are as the squares of the diameters, the capacities (and consequently the weight of water they can contain) as the cubes; and thus by augmenting the capacity of the vessel, the weight of the vessel is immediately overcome by the weight of what it can contain, and the vessel may float.

Whether it is possible to make a globe of metal to ascend and float in air.

7. From this principle *Franciscus Lana*, an ingenious jesuit, in an *Italian* treatise, entitul'd *prodromo della arte Maestra*, had conceiv'd hopes, that a brass-globe might be made of such a capacity, that when exhausted of air it might ascend and float therein; and for this purpose he was of opinion that 16 feet in diameter was sufficient; but I found by calculation, that we must have a globe of an immense bulk, and which cannot be easily prepar'd by human skill, or one that should withstand the immense force of the incumbent air: And this I thought proper to shew by a calculus; because it will, at the same time, appear how great the tenuity of aqueous particles in vapours must necessarily be, in proportion to the rarity of the included air, that such vapours may mount upwards.

This attempted by a calculus.

8. It is verified by experiments, that the specific gravity of water is about 800 times greater than that of common air: But let us suppose it to be d times greater than the specific gravity, or the density of the air included in a bubble; and that the weight of common air of the same bulk with a bubble of the vapour, of which we are treating, to be p ; let the centre of the bubble be *A*, and *AB* the radius of the sphere of included air, but *AC* the radius of the sphere of the whole bubble, the space of included air will be

be as the cube of AB , the space of the whole bubble as the cube of AC , and the space which the pellicle occupies as the difference of these cubes: Let us suppose that space of the pellicle to be to the space of the whole bubble as 1 to r , the space of the pellicle will be as the cube of $\frac{AC}{r}$, which is equal to the cube of AC — the cube of AB : Therefore, the cube of AB is equal to the cube of AC — the cube of $\frac{AC}{r}$ equal the cube of $AC \times 1 - \frac{1}{r}$ equal the cube of $AC \times \frac{r-1}{r}$: And therefore, the cube of AB is to the cube of AC as $r-1$ to r . But the weight of the included air is to that of common air of equal bulk with the bubble, or to p in the compound ratio of the volumes (of the cube of AB to the cube of AC , or $r-1$ to r) and of the specific gravities (1 to d) that is, in the ratio of $r-1$ to rd : The weight, therefore, of the included air will be $p \times \frac{r-1}{rd}$: The weight of the including pellicle of water will be in like manner to the weight of common air of equal bulk with the bubble in the compound ratio of the volumes (1 to r by the hypothesis) and of the specific gravities (800 to 1 by experiments) the weight of the pellicle, therefore, will be $\frac{800p}{r}$; but adding the weight of the pellicle to the weight of the included air, we shall have the weight of the whole bubble, which will be $\frac{p \times r-1 + 800d}{rd}$ and that should be less than p the weight of common air of equal bulk with the bubble, that the bubble may ascend therein; and $r-1 + 800d$ will be less than rd : And therefore, $rd-r$ will be greater than $800d-1$; and therefore, r will be greater than $\frac{800d-1}{d-1}$, or the ratio of the space of the bubble to that of the pellicle will be greater than $800d-1$ to $d-1$: Whence if d be 10 , or if common air be 10 times denser than the included air, the ratio of the space of the bubble to that which the pellicle occupies will be greater than the ratio of 7999 to 9 , or greater than 888.777 , &c. to unity; where 888 are unities, but 777 , &c. is a decimal fraction, to wit, $\frac{7}{10} + \frac{7}{100} + \frac{7}{1000}$, &c. as you would incline to be more exact: And therefore, the space of the whole bubble will in this case exceed that of the aqueous pellicle upwards of 888 times.

9. But if any one would determine not only the ratio's of the spaces or volumes, but also the ratio of the thickness of the pellicle to the radius of the spherical bubble, that is, not the ratio of bodies but of lines, he will have occasion for the extraction of the cube root, which we have hitherto avoided: For, the thickness of the pellicle is to the radius of the bubble, which is AC as $AC - AB$ to AC ; but AB is to AC as $\sqrt{\frac{r-1}{r}}^{\frac{1}{3}}$ to $\sqrt{\frac{r-1}{r}}^{\frac{1}{3}}$: The thickness, therefore, of the pellicle is to the radius of the bubble as $1 - \sqrt{\frac{r-1}{r}}^{\frac{1}{3}}$ to unity: Besides $r-1$ is to r as $\frac{r-1}{r}$ to unity; and since r is greater than $\frac{800d-1}{d-1}$, $\frac{1}{r}$ will be less than $\frac{d-1}{800d-1}$; and $1 - \frac{1}{r}$ will be greater than.

than $1 - \frac{d-1}{800d-1}$, or than $\frac{800d-1-d+1}{800d-1}$, or than $\frac{799d}{800d-1}$: Therefore $\sqrt{\frac{r-1}{r}}^{\frac{1}{3}}$ is greater than $\sqrt{\frac{799d}{800d-1}}^{\frac{1}{3}}$: Therefore, at length $1 - \sqrt{\frac{r-1}{r}}^{\frac{1}{3}}$, or the thickness of the pellicle, if unity express the radius of the bubble, is less than $1 - \sqrt{\frac{799d}{800d-1}}^{\frac{1}{3}}$, that the bubble may ascend in common air.

The magnitude and thickness of a metalline sphere that shall float in air determined by calculation.

10. And because by a like calculus, and likewise with more ease, it may be estimated what the bigness and thickness of the metalline sphere, exhausted of air, should be; so that it may float in our air, I suppose the specific gravity of the metal to be to that of air as m to 1: And as instead of a pellicle of water we use a hollow metalline sphere, therefore, for 800 there will be m ; and instead of $\frac{800d-d}{800d-1}$, there will be $\frac{md-d}{md-1}$: But as upon supposing the greatest sensible exhaustion of the sphere, the density of the air remaining in it may be reckon'd none, we shall have d (a number expressing the ratio of common air to included air) an infinite number; and thus $md-1$ will be $=md$; and therefore, instead of $\frac{md-d}{md-1}$, we shall have $\frac{md-d}{md}$, or $\frac{m-1}{m}$, the number d vanishing, by which the different densities of the air are compar'd; the ratio therefore, of the thickness of the metal to the radius of the sphere, will be less than the ratio of $1 - \sqrt{\frac{m-1}{m}}^{\frac{1}{3}}$ to unity. The same thing would have come out, if at the very first we had neglected the weight of the included air, nor should we have occasion for an infinite number; but such a number was of use that the cases of rarefied and entirely exhausted air might be compriz'd in one calculus. The gravity of copper is about 9 times greater than that of water: It will, therefore, contain the gravity of common air 7200 times, and $\frac{m-1}{m}$ will be $\frac{7199}{7200}$, or $\frac{7199 \times 30}{8 \times 27 \times 1000}$, or 215970 divided by $8 \times 27 \times 1000$, where the cube root may be exactly extracted from the divisor, and it gives $2 \times 3 \times 10$ or 60; and therefore the cube root of $\frac{m-1}{m}$ will be the cube root of 215970 divided by 60; therefore, the cube root of $\frac{m-1}{m}$ will fall between $\frac{59997}{60000}$ and $\frac{59998}{60000}$, that is, $\frac{59997}{60000}$ will be less than the said cube root, and $\frac{60000-59997}{60000}$, or $\frac{3}{60000}$, that is, $\frac{1}{20000}$ will be greater than $1 - \sqrt{\frac{m-1}{m}}^{\frac{1}{3}}$, whose ratio to unity is greater than the ratio of the thickness of the metal to the radius of the sphere; the ratio, therefore, of $\frac{1}{20000}$ to 1 or 1 to 10000 will be still greater than the ratio of the thickness of the metal to the radius of the sphere; the thickness of the metal, therefore, is to be assum'd less, or if that be given, greater than the sphere: At length, therefore, the radius of the metalline sphere will contain the thickness of the metal more than 20000 times, that the exhausted sphere may float in water; and therefore, if the thickness of the metal be 1 inch, or 2 or 3 inches, the diameter of the metalline sphere will be 3333, or 6666, or 9999 feet;

feet; and in the mean case, to wit, that of 2 inches and 6666 feet, the diameter of the sphere will be more than 1000 paces; but if the radius of the sphere were only 8 feet, as *Franciscus Lana* would have it, the thickness of the metal should have been $\frac{1}{2500}$ of a foot, that is, less than $\frac{1}{200}$ of an inch, which is impossible.

11. Nor is it, indeed, to be suppos'd that the thickness of 2 inches is sufficient to sustain the immense incumbent bulk of the air: For, how could so small a thickness sustain a weight as great as that of water diffus'd for 1000 paces and rising to the height of 30 feet, which weight would be equal to that of the air; and neither can that accurate uniformity of a spherical arch, which would be requisite, be obtain'd in practice; since neither the uniformity of materials can be obtain'd: And making the thickness twice or three times greater, the incumbent weight is 4 or 9 times greater, not to mention any thing of the sphere's own weight; and tho' it should be granted, that by a thickness of the arch 2 or 3 times greater, its resistance is more than 4 or 9 times: And this in theory (that is, if we could actually perform what we conceive possible) the problem would at length be possible, yet in practice to form spheres of so immense a bulk, and that of metal, as copper, or iron, exceeds human power: And here, therefore, God has put a bar, so to speak, to human attempts; and that not without reason, to restrain the wickedness of those who should attempt to fly in the air.

Tho' true in theory, yet not practicable.

Of the Diseases of Corn, as Tares, Mildew, and Smut. From the Breslaw Collection, September 1717, Class IV. Art. VII. p. 73.

Translated from the HIGH-DUTCH.

AMONGST the principal, and at the same time most noxious diseases of corn, have always been reckon'd the following, *viz.* 1. Tares, when the form of the rye itself seems to degenerate; 2. Mildew, when some sorts of corn exceed in bulk, form, and colour; and 3. Smut, when the substance of the corn is entirely vitiated, as if it were destroy'd by a mortification; yet some sort of this corruption is worse than other.

The several diseases of corn.

1. What tares properly are is sufficiently known, without expatiating into a long description on them; only we must premise this observation, that many consider them not so much as a bare degeneration of corn, as rather a particular species of corn: Whereas, on the contrary, most husbandmen themselves usually regard them as nothing other than a degenerate corn. As in *Silesia* there was a great crop of tares, yet in one place greater than in another, we have been credibly inform'd, that in reality

Tares what?

they are nothing other than a real corn, but of a degenerate nature; and we had the following circumstances communicated to us both by men of quality and learning, as well as by farmers, *viz.* 1. That they really grow from actual pure corn. 2. In a wet and moist season. 3. In low, deep, four lands, especially woody lands, and woods turn'd into corn-land, and likewise on poor, sharp bottoms, that have been sown for some years successively; as there are some such places, where if corn has been sown for three years running, the last year it generally degenerates into tares. 4. Most of all in deep furrows. 5. Principally and almost solely from winter, but not from summer-sowing. 6. That the good seed of the tares in a good, warm and dry season, on fresh, dry and otherwise good land, is again actually chang'd into good pure corn; whereas 7. When the tare-feed is not very good and heavy, it usually does not come up: And to illustrate this the more, we shall alledge the testimony of a gentleman of *Wartenberg*, as both a learned and intelligent husbandman. He informs us, that in harvest if the fields are sown wet and sneary, as it were, it certainly proves a good year for tares; the reason is, that as the seed must lie for a long time in the cold and wet in the earth, before it can come up, the fruitful part thereof is corrupted and tainted; yet there still remains a little mealy or milky substance therein; which, when the genial warmth of the spring comes on, will not remain in the earth, but discover how little fruitful it is; but as it has not a sufficient strength to produce true corn, it yields a species in some measure resembling it, yet by far not so mealy, and then this is what we call tares: Now that tares have their original from corn I prove thus; being sown on high, dry, yet good land, they again change into corn, and again resume their first form, which could not be the case, if in tares there were not the species and quality of rye or corn conceal'd: But such tares as are so little mealy and, as it were, nothing but hulls, do not spring up, but moulder away. In the same manner we have been assur'd by another learned person of *Brieg*, that a neighbour of his had the preceeding year sown a quarter of the best tares in a good soil, from which he reap'd much corn and but little tares; the soil is somewhat greyish: And thus *Bruyerinus*^a has also remark'd; 'tares, says he, proceed from wheat, and wheat from tares.' As we have been well assur'd of this transformation from several quarters, so also from *Hungary*, with this additional circumstance, that indeed all tare-feed does not turn to corn, and that if once it becomes hully: And it is certain, that sometimes bad husbandmen give occasion to a rich crop of tares, when either out of thoughtlessness or necessity, and often also out of knavery, they sow impure and base tarey feed, as happen'd some time ago in a certain farm, where the farmer sow'd tares and again reap'd tares. On the contrary, his successor, upon sowing good feed, also reap'd good pure corn from

^a *De re cib. lib. 5. cap. 3. p. 247.*

from the same field: And possibly were the method among the *English* taken, which is, not to sow the seed again in the same field where it grew, but always fresh seed from other parts^b, we might possibly often reap purer corn and less tares; tho' indeed it must be own'd, that a bad sour soil cannot be improv'd even by the best seed, especially when the soil is more apt to produce tares than good corn, as we have been assur'd of this from *Thuringen*. Yet among all the diseases of corn tares are the best, seeing they yield meal, yet but little in quantity and of somewhat a bluish cast; but they are in a particular manner improv'd by the following method; to a bushel of tares is added the same quantity of barley and corn; and as the miller is oblig'd to give as much meal from the worst as from the good corn; so in this manner there is a greater profit than from the good corn, tho' the good may be sold for a better price than the tares: The bread bak'd of it is, indeed, somewhat dark, and yet not unsavory, yet in baking it does not rise so well, and therefore it requires a stronger leaven. They use in some places of *Silesia* a kind of fanning mill for separating the good corn from the tares, &c. whereby the cleansing of corn is perform'd speedily and better than with the fan, tho' still somewhat of the heavy tares remain behind; it has four wings, yet that with six is better; and that such kind of winnowing mills were a small time ago first begun to be known in *Saxony* and *Brandenburg*, *Wolfius* testifies^c in his *Aerometria*. This kind of bastard-corn has this year been pretty plentiful in *Silesia*; so that few corn-proofs have been found entirely without it: The reason of which was the moist seed-time the preceeding year, and a wet cold spring, as also bad feed.

Pl. III. Fig. 5. 6.

2. As we have had here and there this harvest no small store of mildew'd corn, so that often on one ear many such grains stood jutting out, and sufficiently shew'd the luxuriancy of the sap by the bigness of their growth: Yet it is also certain, that they were not so commonly observ'd as the preceeding year, since in several places there were few or none at all: They ow'd their rise chiefly to the following wet weather in *July*, or also, as was suppos'd, to the preceeding honey-dews in bloom time; yet we have no where found, that they have been in any uncommon manner prejudicial to the health, tho' by most of the old physicians, and in particular by those of *Lausnitz*, *Saxony*, &c. an epidemical convulsive distemper has been ascrib'd to them: Whereas, on the contrary, a certain learned physician has sent us an essay, wherein he shews the insufficiency of such a cause.

Mildew what?

1. That when this disease raged at other times, as in 1596 in *Cologne*, *Westphalia*, &c. no such cause was assign'd. 2. That the experiments about this corn on beasts are insufficient and inadequate. 3. That the circumstances of this disease are founded on hearsay, and the opinion of the patients. 4. That if this corn were poisonous, whole families, nay vil-

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lages

^b Monconnys *Voyage Angleterre* p. m. 516.

^c § 195.

lages must have been infected with it. 5. That many had this distemper who never eat of such corn. 6. That people have been still dubious about the efficacy of this cause, since also other causes were complain'd of, 'as poisonous dews, fogs, hot bread, bad garden fruits, a bad summer, &c. 7. As moreover neither men nor beasts sicken'd on whom these dews or fogs fell. 8. Not to mention, that this corn was also exported and lasted for a long time, without causing this distemper. 9. Besides, this disease has its period and paroxysms, whereas poison, on the contrary, exerts a continu'd effect. 10. As the symptoms gave no signs of poison, but were in common with other spasmodic affections; tho' it is not to be denied, that bad provisions have been the occasion thereof in many, already dispos'd to such disorders, but whose principal cause we are to seek for in the concurring moist, cold, summer weather, in which manner also *Joh. Georg. Hoyer*^d (in his epistolary dissertation to *Luc. Schroeckius* of the epidemical constitution at *Muhlhausen* in 1700) mentions, that that year in and about *Muhlhausen* there rag'd spasmodic affections, and by some ascrib'd to mildew'd corn, which plentifully grew in *Thuringen* the preceeding year; yet he could not prevail with himself to be entirely of this opinion, as the then concurring cold, wet and open weather was the principal cause of this disorder, which soon became more tolerable, as the weather became better: And we ourselves could have no account, that such disorders either this or the preceeding year were caus'd by the said mildew'd corn; tho' besides, especially this year, in most parts of *Silesia*, a great deal of mildew and honey-dew fell, which sometimes entirely moisten'd and cover'd with a paste, as it were, the ears of corn, that it often hung therefrom in form of drops, or icicles, and also produced many maggots and caterpillars: And besides, we have been assur'd by a farmer, that in his youth along with his comrades he had gather'd this mildew'd corn, and eat handfulls of it, without the least prejudice to his health, tho' he could not deny, that if one eat much of it, it tasted somewhat nauseous: So that thus in epidemical diseases we are to make a great difference between the material, continent and efficient cause, and the occasional, succedaneous and remote cause: However, *Camerarius's* observation in the *Miscellanea Naturæ Curiosorum*^e, on the nature and noxiousness of this mildew'd corn, deserves to be perus'd.

Smut what?

3. A great deal of smut was observ'd this year among the wheat, but in few places among the rye, which is less subject to this disease than wheat: And this blight or smut was observ'd in the month of *August*, and 1. principally in wet and deep lands; 2. or where the sowing was too late; 3. or where the seed was already blasted; not indeed, as if the blighted corn could come up, which is a thing impossible, but the good seed was polluted

^d *Misc. Nat. cur. cent. 1. § 2. app. p. 48, seq.*

^e *Cent. 5. § 6. Obj. 82. p. 343, seq.*

luted with the smut-dust, and infected with it, as with a contagion: As it is reckon'd the peculiar plague of corn, which in threshing, smutts both the corn and the thresher all over, that after a great deal of washing it cannot be entirely got out of the corn; 4. to which some would add, that when the sowing has been perform'd by a double light, that is, when either in the morning or evening the sun and moon are observ'd at the same time in the heavens; 5. but in particular, while here and there new wheat is sown moist; 6. not to mention, that the honey-dew and the wet weather in *July* did remarkably contribute thereto: And to this we shall add a curious passage from the account of the above-mention'd gentleman at *Wartenberg*, and which is as follows: 'As to smut, it is for the most part found in wheat and millet; and in my opinion proceeds hence, namely that new wheat is sown moist, before it is well dried and air'd in the loft; because when wheat which is more than a year old is sown, we need not in the least be afraid of smut; yet with this precaution, that that year old wheat is better, which has still remain'd in the ears in the barn, and has been threshed out a little before it is sown, than what has lain for a year on the loft; seeing a great deal of the generating quality of this last is already evaporated and lost: Wherefore, all prudent husbandmen avoid using old seed, as often scarce the half thereof comes up. Yet intelligent farmers will alledge, that when a poisonous mildew falls upon the wheat in bloom, it is afterwards subject to much smut. The remedies against smut are manifold, but for the most part superstitious: I shall only advance one, which I have seen used with good success, not only in the *Netherlands*, but likewise in *Germany*. To a coomb of wheat they take from one to one peck and a half of unslack'd lime, which they beat small to meal, and afterwards sift it on the wheat, and then shovel them well together; and again sweep them up with a new broom, and this they sow in the old of the moon. The best means against smut in millet, is before sowing to let it run softly thro' a burning wisp of straw, which I myself have found to have answer'd, tho' I have been contradicted therein, and told that I must use old thatch; but this favours of superstition. Others also scald the millet with boiling hot water, but as thus it may be very readily boil'd, the first method is the surer'. And possibly it may be of some service here, if according to the manner among the *English* farmers, as mention'd above, seed be always bought from other parts, and your own produce us'd in other consumption; or if by means of a cord the dew were shaken off the wheat, or the seed steeped for 24 hours in sea or salt water, mixt with bole^f. To this we add, according to the observation, made in the above account (to wit, that of keeping the seed till seed-time in the ears) that in the Canton of *Switz* corn may be kept good for

^f Morconny's *Voyage*, p. m. 534.

for 80 or 100 years, if it is preserv'd in the ear^s: And to this in the last place we subjoin, that *Rud. Jac. Camerarius* in 1709 had a learned disputation at *Tubingen*, entitul'd *de Ustilagine Frumenti*, wherein the above causes are illustrated with several examples and reasonings.

The explication
of Fig 5. Pl. III.

The external view of the fanning mill.

A the place where the corn is shot in.

B the air-vents near the wheel.

C the handle, by which the wheel is turned round.

D a hole at which the clean corn comes out.

E the hole for the tares on the other side.

F wheels and handles for carrying along the mill.

Fig. 6.

The internal view of the fanning-mill.

A the wheel with six flat wings.

B the ring in which the wheel moves.

C the place where the corn is shot in.

D the place where the corn falls down freely, and is fann'd by the wings of the wheel.

E the place where the heavy and pure corn falls.

F the place where the tares and light corn fly away.

G the place where the dust and the hulls are blown away.

NB the upper part of the case of the mill, which is made to take off, in order to have access to the wheel.

§ *Id. ibid. p. m. 528.*

An experimental Dissertation on the Direction of heavy Bodies in a spherical Vortex, and on the Figure of the Nucleus. By G. B. Bülfinger. From the Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 245.

Translated from the LATIN.

The occasion and
design of this ex-
periment.

I, **T**HERE are many years, since on occasion of a letter of *Jac. Bernouilli's* to *J. Chr. Sturm*, and publish'd in the *Acta Erud. Lips.^a* it seem'd to me that such reason'd well, who from the motion of a spherical *vortex*, such as *Des Cartes* suppos'd, revolving round the axis of a sphere, conclude, that heavy bodies by means thereof ought rather to tend to the axis than to the centre of the earth: For, supposing, as *Des Cartes* would have it, that both the æther and air consist of corpuscles more susceptible of a violent motion than terrestrial bodies, and adding to this, and which appears by common experiments, that bodies dispos'd to a more violent motion, do more strongly tend to the periphery,

^a *Annus 1686 M. Febr. p. 92 seq.*

phery, if they happen to move in a circle; and therefore, that other things are propell'd by them to the centre of that circular motion: It is certain, that terrestrial bodies are by that impulse brought together from the periphery to the centre; but what centre? Is it the centre of the sphere itself, and of the entire *vortex*, or the centre of a circle, parallel to the equator of the *vortex*.

2. The *Cartesians*, to make their explication come the nearer to the *phenomenon* of gravity (for explaining which these hypotheses of the *vortices* were intended by *Des Cartes*) have deriv'd from that action of the *vortex* a *conatus* to the centre of the sphere itself, and by that means they have endeavour'd to explain the direction of heavy bodies and the spherical figure of the earth. Gravity and the spherical figure of the earth how explained by the *Cartesians*.

3. Amongst a great many others *Christ. Huygens* has in particular oppos'd the *Cartesians*; for, he supposes, that from that motion of the *vortex* there follows an impulse of heavy bodies not to the centre of the whole sphere, but to that of the circles parallel to its equator, or to its axis; which is exactly what *Kepler* had said before *Des Cartes* and explain'd by a figure in his *Epitom. Astron. Copern^b*. That explication oppos'd by *Huygens*. Fig. 7. Plate II I

4. This at first blush is more plausible; for, it seems consonant to reason, that if two bodies moving at the same time in any circular plane have unequal *conatus*'s; and consequently, the weaker body be repell'd by the stronger, that the former be repell'd in the same plane in which both have a *conatus* to go on in their motion; this reasoning, therefore, a great many more have given in to And in this follow'd by others.

5. *Huygens*, that he might not seem only to refute an error, and that he might find something proper to explain the *phenomenon*, has (in order to obtain the directions of heavy bodies, perpendicular to the horizon, and the nearly spherical figure of the earth, generated by a *vortex*) substituted instead of *Des Cartes*' gyration another, by which the subtile matter included in a spherical superficies, moves therein with an infinite variety of directions, along the small arches of the great circles of a sphere: Almost of the same kind is that, which *Job. Christ. Sturmius^c* hints at in a letter to *Hen. More*; namely that the circles or rather the arches, describ'd by each particle of the subtile matter, are to be conceiv'd so, as that all of them may be taken to acquire the *impetus* of their gyration from one point of the sphere. A great many others, and lately *Wolfius* in his system of physics have follow'd *Huygens* in this opinion of the *conatus*; but as to the difficulty, or rather impossibility of such a kind of *vortex*, *Jac. Bernouilli^d* has oppos'd *Sturmius*, and *Saurin*, *Huygens*. Gravity and the spherical figure of the earth accounted for by *Huygens*.

6. *Saurin* has reinforc'd the *Cartesian* cause, and endeavour'd to re-establish it fully in its tottering condition, having for this purpose publish'd *Saurin's* defence for the *Cartesian* vortices. two

^b P. 97.

^c Colleg. Curios. P. II. § 23. p. 23.

^d l. c. *Act. Erudit. Lips.*

two dissertations, the first of which is extant in the *Journal des Sçavans* in which he has not only labour'd to invalidate *Huygens's* reasonings against the *Cartesian vortices*, but likewise to demonstrate, that from the re-action of a spherical surface encompassing a fluid *vortex*, a *nifus* towards the centre of the sphere is generated: The second is publish'd in the same *Journal*^f; and in the first place he urges for *Des Cartes*, that if the *vortex* were at first conceiv'd to be cylindrical, yet that by its pressure on the adjoining fluid it would be reduced either into a spherical or spheroidical figure: And again that the motion of the *vortex* revolving about the axis of the earth from west to east is much more agreeable to the *phenomena* of nature than those interrupted portions of gyrations, perform'd, according to *Huygens*, in great circles. I find by the *Memoirs of the Royal Academy of Sciences at Paris* §, that *Parent* and *Montrè* have oppos'd some things to *Saurin's* first dissertation; but which have been so far from diverting that ingenious author from his opinion, that he has rather taken what he has oppos'd to *Huygens* for things perfectly demonstrated.

The authors
opinion on the
dispute.

7. May I, therefore, be allow'd to own, without the displeasure of any one, that in so difficult a matter and involv'd in so many circumstances, I have always had some doubt about the evidence of the demonstrations, hitherto given; and therefore, have often wish'd, that the matter might be decided by plain experiment, especially as I saw, that the greatest men, as for instance, *Jac. Bernouilli*^h, were in doubt, whether from the nature of a spherical surface it may be deduced, that the *nifus* of corpuscles, propell'd from the periphery, tends rather to the centre of the sphere, than to that of the parallel circle; for, tho' I thought I understood the reason, why it should not happen, that the corpuscles tend to the centre of the sphere; yet in a matter of difficulty I inclin'd not to interpose my judgment, or to precipitate a conclusion before nature was consulted by experiment.

Huygens's experiment to account for the cause of gravity not satisfactory.
Fig. 8. Plate III.

8. *Huygens's* noted experiment, usually employ'd in the cause of gravity, came easily into my mind, wherein assuming a cylindrical vessel of 8—10" in diameter, and 4—5" in height, he fill'd it with water and shavings of *Spanish wax*; he cover'd it above with a glass, and laid it on a wooden table, by means of which it might be turn'd round very swiftly; for, by this swift motion of the vessel, and again suddenly stopping it, it happen'd, that the water still for some time continued its gyrations and collected the shavings of the wax about the centre of the base of the cylinder in a heap like a hemisphere; yet this did not satisfy my design, because it seem'd to me, that there were such circumstances in this experiment, as neither the *vortices* of *Des Cartes* nor those of *Huygens* admit of; if there are any spherical *vortices* in nature; and especially the production of

^c *An.* 1703 p. 38. seq.
Ed. Bat.

^f *An.* 1707. M. Maii. p. 327. seq.
^h *l. c.*

§ *An.* 1709. p. 167.

of a *nucleus* only hemispheroidical, and a cylindrical *vortex*, and the bottom of the vessel supporting the bodies seem'd to be circumstances little suitable to determine this question.

9. I, therefore, in the first place began to think, whether matters might not be so order'd, that instead of a half, an entire *nucleus* might be produced: For, the design of the *vortices* in the heavens, assum'd by *Des Cartes* and *Huygens*, is the genesis of a sphere; and here it easily came into my mind, that if a cylindrical vessel were divided in the middle by a partition, parallel to the basis, and in its lower part, corpuscles not much specifically lighter than water were mixt therewith, it might probably happen, that below, half the *nucleus* would be collected in the middle of the partition, as well as above, greater or less according to the greater or less quantity, or different specific gravity of the matter employ'd. I tried something to this purpose, and not altogether without success; yet the manner of doing this experiment dextrously is difficult, and the *vortex* ceases not to be cylindrical: Not to mention the influence of the gravity and levity of the corpuscles, mixt with the water, upon the figure of the *nucleus*; for, such *nuclei* as I obtain'd were not, indeed, spherical.

Whether that experiment might not be improv'd.
Fig. 9. Plate III.

10. I, therefore, thought it still proper to lay aside such cylindrical *vortices* as more remote from this *phenomenon*; and to imitate nature more nearly by causing rather a spherical *vortex*, in which, in imitation of *Huygens'* experiment, corpuscles specifically heavier should at first indeed be carried away by the water moving in the revolving vessel; and therefore, as I conjectur'd, that during the gyration of the vessel, they would possess the sides; but upon the ceasing thereof they would be driven to the more internal parts by the water continuing its motion longer; and would exhibit a figure, as might be easily guess'd, either spherical or cylindrical.

Farther improv'd

11. It is only some few weeks ago, that I had an opportunity of putting this design in execution, tho' I had had such a thought for three or four years before, having for this purpose employ'd glasses and machines, such as *Hauksbee* at first, and afterwards others have hitherto us'd to excite light by the friction of the hand; and that with greater success than I had at first imagin'd: For, intending to observe the figure, which, upon the ceasing of the motion of the glass, and the water only revolving therein, the parts of the wax, propell'd by the water, would acquire; the air, which forced itself upon me and every where separated itself from the water, during the gyration both of the glass and water, put on such a figure, that I was not a little pleas'd, that the motion of the wax and water, returning to a state of rest, was disturb'd by it; and consequently, that the genesis of the figure, which I had expected from the particles of the above wax, did not succeed.

The author's apparatus for determining this matter.

The circumstances of this experiment.

Experiment.

Pla. III. Fig. 10.

12. The more remarkable circumstances of that experiment, several times repeated before the *Society*, are the following.

I took a glass in some measure spherical; for, the diameter of the equator is greater than the other diameters; and the poles terminate as in a kind of truncated cone: It is furnish'd about its poles with metalline cylinders with prominent axes, in one of which is seen a lesser wheel fix'd, round which a thread may be pass'd, having a groove in it for that purpose. I fill'd that glass by the hole of the other cylinder with water, and with a little of the powder of black *Spanish* wax and iron filings, and fitted it to the machine, by means of which the rotations of the like glass-spheres for exciting light by friction are otherwise usually perform'd.

13. I then began to turn round the handle of the machine, that the glass might begin to revolve, and I observ'd; 1. That in the upper part of the glass was seen a bubble (as it is call'd, or rather a segment) of air, which upon the rotation diverted to that part, towards which the rotation was directed. 2. But that it was cut in its middle before it diverted, by the water tending to the outmost parts of the sphere. 3. Upon continuing the motion for a little time, the wax and iron-dust adhered to the sides of the glass about the equator of the motion, in manner of a zone. 4. After first being thrown upwards by a few impulses it had again fallen down by its gravity. 5. Upon the ceasing of the motion of the glass, the air by its ascent disturb'd the motion of the water; and so hinder'd that the expected impulse of the wax and filings to the centre or axis could not be regular: This was the first essay.

14. Having, therefore, again fill'd the glass, so that upon inverting it no bubble of air could be observ'd at its upper part, I again renew'd the gyration and I observ'd; 6. Lesser bubbles of air burst out up and down in the water, and collected into larger ones; and the motion afterwards ceasing, I saw a great many of them adhering to the particles of the *Spanish* wax; 7. Upon a quicker motion these particles of air came afterwards from the side towards which they diverted N^o 1. nearer to the axis of the sphere and rotation; 8. And at length exhibited an elegant cylinder, which 9. As the motion was swifter became more slender, in which notwithstanding, 10. These bubbles of air were not contiguous to each other, but revolv'd among the water: 11. Upon remitting a little the swiftness of the motion, that aqueo-aereal cylinder became of a greater diameter; and consequently, so to speak, of a looser texture; 12. Whether upon increasing the swiftness of the motion those bubbles might be collected into a continued cylinder, I would not try, for fear of hurting the glass, being hitherto the only one I had for this experiment; 13. If by the remission of motion the bubbles, separated before, came together into larger ones, their figure was not spherical but broader at that part, from which the impulse of the revolving water came, and more enlarged at the opposite part:

part; 14. It was a very elegant sight, that upon admitting the air in a greater quantity, and the cylinder still continuing very broad, some bubbles of air did not go beyond the centre of the spherical *vortex*, but from the right side, whither the descending water tended, form'd, as it were, elliptical *gyri*; others, going beyond the centre of the *vortex*, form'd spiral lines, such as *Cassini* has describ'd for the motion of the planetsⁱ.

Let LMNO be a section of the equator, or of a circle, parallel thereto in the spherical glass; let ABCD be the section of a cylinder, *abcd* will represent one gyration, and EFGHI other gyrations more freely represented. 15. When the motion of the glass was stopp'd, and the aereo-aqueous cylinder was somewhat larger, I saw in a very little time, that that cylinder still revolving was brought into a narrower compass, and then at last become larger again and dissolve. 16. The aerial bubbles at length ascend to the top, but most of them larger, rather with a retrograde than direct motion. Let ABC express the direction of the water in the vessel now at rest, let B be its top, and let the bubble revolve along *pqr s*; it very rarely happen'd that it would come from *p* through *q* to B, but those coming from *q* through *r* to *s* return'd back from thence to B, there afterwards to continue.

Pl. III. Fig. 11.

Fig. 12.

15 The other things occasionally observ'd in these trials were much to the following purpose: 17. The *Spanish* wax and the filings of iron form'd a zone or kind of zodiac about the equator; 18. Yet of an unequal density, and if we would be more accurate in the observation, of an unequal breadth; 19. There was a part of it, which, upon the velocity of the rotation remitting a little, separated itself from the rest, and receded more or less from the equator, representing a tropic or polar circle. 20. It was moveable, either as the motion intended or remitted a little; and therefore, forming spirals on the concave surface of the sphere; and 21. If the swiftness of the motion was much diminish'd, that part hid itself in the polar cylinders. 22. If the motion of the glass was stopp'd, part of the dust about the equator of the *vortex*, fell down by its gravity, but irregularly, by reason of the disorders, produced by the aerial bubbles ascending here and there.

Fig. 13.

16. In the former trials not a hundredth part of the capacity of the vessel was fill'd with air; but when a greater quantity of air was admitted, so as to occupy a fourth, fifth, and sixth part of the vessel, and the velocity of the gyration was somewhat intended; 23. The air was collected into a cylinder about the middle of the sphere, free from any water and whose inmost surface appear'd very smooth; 24. Nor is there requisite a great swiftness of rotation for preserving this cylindrical *nucleus*, after it is once produced; 25. And it continued so long, tho' the motion

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of

ⁱ *Mem. de l'Acad. An.* 1709. p. 328.

of the sphere was stopp'd, till the revolving water lost both its motion and *conatus* by the friction at the sides of the glass.

Conclusions.

17. Having hitherto narrated the *phenomena*, it might be an easy matter to enquire into the causes of each in particular, as also to show the laws of *vortices*, by which *phenomena* might be obtain'd that have hitherto been despair'd of, as for instance, the alternately greater and lesser spirals of the celestial bodies, and the like; but that does not belong to our present design, wherein we only labour to define the figure of a *nucleus* to be generated by a spherical *vortex*; and by that very thing to pave the way for the solution of the mechanical problem, whereby the laws of *vortices* are requir'd to be such, that a spherical *nucleus* may arise.

18. We have, therefore, inserted here principally two conclusions, the one regards the thing, the other the manner of reasoning about *vortices*; and both of them seem useful and necessary in explaining the cause of gravity.

19. It, therefore, appears by experiment and by the eye, that in a spherical *vortex* revolving about the axis of a sphere, the ceding corpuscles, that is, such as are driven by the impulse of the vortical fluid from the periphery towards the centre, do not coalesce into a spherical but a cylindrical *nucleus*; and therefore, that from such a *vortex* alone, the direction of bodies ceding towards the centre of the *vortex* is not exactly enough deduced but that that direction tends to the axis of gyration.

20. The doubt, therefore, is removed, by which hitherto the learned have run into different opinions, since nature has discover'd by an obvious instance what it does concealedly when it turns round *vortices*, according to *Des Cartes'* mind; and I think that in this experiment the conditions of the desir'd *vortex* is express'd to pretty good advantage. We have a fluid included in a spherical surface, and made to revolve about the axis of a sphere.

21. It is true, that the rotatory motion is impress'd on the water by the action of the ambient surface, and that it is carried along with the water towards the same part. You may, probably, alledge for *Des Cartes*, that the vortical motion is in nature otherwise impress'd, and that the including surface is at rest; but that will not affect our inference. Whatever be the manner wherein the motion is at first impress'd on the *vortex*, we consider it in a continuing state, in which case rest is no obstacle to the outmost surface, as we have seen N^o 15 and 25 in the experiments: What we have alledged § 19 stands, therefore, good.

22. Let the other be this; in order to judge of the direction of the centrifugal force of the particles of the fluid revolving about an axis, that plane which is parallel to the equator ought to be taken into the account, but not the plane of a meridian or other great circle on the sphere. This appears

appears from the cylindrical figure of the *nucleus*, by means of which the direction of the ceding bodies is perpendicular to the axis in planes parallel to the equator.

23. But it is of service to observe this, because if we would employ reasoning alone, the thing might appear dubious: On one side I infer thus, because the motion itself, from which the centrifugal force arises, is not along the meridian of the *vortex*, or any other great circle intersecting the equator, but along circles parallel to the equator, the direction of the centrifugal force of any particle will, therefore, be in planes parallel to the equator.

24. But on the other side, taking in the consideration of a spherical surface, different deductions have been made by others. *Jac. Bernouilli* in the place alledg'd above ingeniously hints, that the planes of a parallel circle, as the tropic, and of a great circle, as the ecliptic, intersect each other in a line, which is a tangent to both circles: If, therefore, the point of contact beginning to revolve along the tropic has a *conatus* of receding along the tangent, we may so far equally reckon upon it, that it recedes from the centre of the ecliptic, and from that of the tropic, seeing they both have the same tangent; that, therefore, there is no reason, why the pulsion of the globules is made in a vertical plane rather than in the plane of a parallel circle, or in any other plane; since that tangent, along which the globule endeavours to recede, is common to infinite planes. This excellent person, therefore, does here doubt, and that from the nature of a sphere.

25. In another place, from this very consideration, he pronounces in favour of *Des Cartes*; for, after having in the same *Acta Eruditorum Lips.^k*, remark'd about the pression of the fluids against the sides of the vessels, that it was perpendicular to the containing surface, he from that inferr'd, that the direction of the corpuscles impell'd back was towards the centre of the sphere, which alone is perpendicular to the surface.

26. In another somewhat different manner *Saurin* came to the same conclusion¹. He (granting that the ceding particles were carried directly to the axis, if a circle parallel to the equator were conceiv'd apart, or constituted in a cylindrical *vortex*) yet denies that the same holds, if a fluid be included in a spherical surface. This ingenious remark deserves to have a place here; 'It is plain, *says he*, that the fluid matter, which in the plane of the parallel circle, whose diameter is DN, has a *conatus* of removing from the point O along OD, and which by its *conatus* propels to the point C the spherical surface, whose circle PAQE is a section thro' the axis: It is plain, *I say*, that that matter is no otherwise repell'd by the surface, which it propels, than it would be by a plane which would touch this surface at the point D. Thus, according to the laws of mechanics,

Fig. 14. Pl. III.

^k *An.* 1695. p. 547.

¹ *Journ. des Sav.* *An.* 1703. M. Jan. p. 40, 41.

'chanics, its effort in this point is reflected against the fluid, which is
 'lateral, according to the chord $DM = DN$: Now this effort being sup-
 'ported by the re-action of the fluid along the same chord MD, it fol-
 'lows, that the spherical surface is press'd at the point D by two equal
 'forces; one of which acts along OD, and the other along MD; from
 'whence there results in this point of the surface an impression according
 'to the direction CD, which is that of the diagonal of the parallelogram,
 'made by the two chords MD and ND. If we now place in the point
 'D a gross body, which has no *conatus* of its own, the fluid matter which
 'acts along OD, and that which exerts its re-action along MD will pre-
 'vail with an equal effort, and propel it along DC towards the point C,
 'which is the centre of the *vortex*, and not towards the point O, which is
 'the centre of the parallel circle: And as the same reasoning holds good
 'what plane soever of the circle we consider, and in what point soever of
 'the plane we suppose the gross body to be, it appears evident to me,
 'that in *Des Cartes'* hypothesis heavy bodies ought every where in falling
 'to observe the same direction, which tends to the centre of the earth,
 'conformable to experience, and contrary to the propos'd objection, &c.'

27. But to what purpose are these things? It is to shew us, that what
 may be doubtful to men however great, but who only reason, is very ob-
 vious and plain even to the most unskillful who takes the experiment, to
 wit, we are to take the perpendicular lines from the periphery of a circle
 describ'd by rotation rather than from the ambient surface; because the
 direction of the ceding corpuscles is not so much perpendicular to the in-
 cluding surface as to the axis of gyration § 19: And what do you think
 would be the consequence, if the superficies were elliptical, parabolical, or
 any how generated by the rotation of the curve ABCDE about the axis?
 Am I mistaken? should it be conceiv'd, as consisting of an infinite num-
 ber of contiguous little cylinders, generated by the rotation of the elements
 PMmp? Or if you will, from infinite cylindrical small rings within each
 other, and having the same axis?

28. At the least this is certain, that by *Des Cartes'* vortices cylindrical
nuclei are generated.

A conjecture.

29. We ask, what should be done, that spherical *nuclei* may be pro-
 duced? Having premis'd what I have said, this problem is not difficult;
 take here the method which led me to the solution.

Fig. 16.

30. We have seen, that upon causing a spherical *vortex*, whose axis
 AB may be parallel to the horizon, we also obtain the cylinder *abcd*,
 whose axis AB is parallel to the horizon. Let us now suppose the axis of
 rotation EF to be vertical to the horizon; and let us abstract from that
 difference, which either the gravity or levity of bodies may cause, we shall
 also obtain the cylinder *efgb*, whose axis EF is vertical to the horizon.
 If you suppose both motions to be conjoin'd on account of the other action,
 which

which depends on the rotation according to the axis AB , the cylinder $efgb$ will be urged from b towards i and from e towards k , from g towards l , and from f towards n ; and *vice versa*, on account of the action depending on the rotation according to the axis EF , part of the cylinder $abcd$ will be urged from a and d towards i and l , and from b and c towards k and m , what sort of figure does hence arise?

31. It seems, indeed, at first sight, that there arises the common section of the two cylinders $abcd$ and $efgb$ (but which acquire a somewhat larger diameter) represented here in some measure by $iklm$; and therefore, the body will be angular, whose angles in i, k, l, m , may coincide with the middle of the quadrants AE, EB, BF, FA : And which, therefore, cannot be avoided, unless by a new rotation according to the axes no and pq , upon supposing which the angles may again fall in with the middle of the spaces $EO, OB, &c.$ so that at last in order to avoid all angles, we must have recourse to *Huygens'* hypothesis of the rotation according to all possible axes, or, which is the same thing, of the recess of the revolving fluid according to all great circles.

32. But it is, indeed, easy to avoid these inconveniencies, if we attend to the genesis of the cylinders $abcd$ and $efgb$; for, the cylinder $abcd$ arises hence, namely, that upon the gyration about the axis AB , each bubble tends towards some point of the axis AB ; and the cylinder $efgb$ arises hence, namely, that upon the gyration about the axis EF , each bubble tends towards some point of the axis EF ; both rotations, therefore, being conjoin'd, each bubble tends towards each axis.

33. To make it tend to a point common to both axes, and consequently, to the centre of the sphere, you may effect thus. Let both *vortices* be equally strong; let the ratio of the revolving fluid, and of the particles immers'd therein be such, that the centripetal forces of the ceding corpuscles be directly as the distances from the axis: It is manifest, that in a ceding corpuscle a compound *nifus* arises, whose direction TO is the diagonal of the sides TQ and TP , tending to the centre of the sphere: This twofold rotation being, therefore, combin'd, there will arise a spherical *nucleus*; for it is a thing receiv'd, that the spherical figure of the *nucleus* may be deriv'd from the direction of the corpuscles towards the centre.

34. But if you doubt of it, suppose an angular body, whose section, for instance, let be $abcd$, by the hypotheses § 33, the force of each particle tending to the centre will be proportional to its distance from the centre bo, ea, fo : And therefore, the more remote particle b will remove laterally the particles e and f next thereto, till all be in *aequilibrio* and equidistant from the centre, that is, till there be a spherical *nucleus*.

35. Let these things abstractly said suffice for understanding what may be requisite and sufficient towards the genesis of a spherical *nucleus* in a *vortex*. How it may be obtain'd by an experiment, I shall explain in an ensuing

Fig. 17.

ensuing dissertation; and then, at the same time, I shall shew how far these things may, or may not be applied to the mechanical or physical doctrine of gravity; for, I imagine I have made some progress in that argument, but that more remains still behind*.

* What I here promise about gravity was afterwards prosecuted in a particular dissertation, publish'd at *Paris* in 1728, because the illustrious *Academy* thought it worthy of a prize: In what is to follow, I do not, therefore, so much regard the application of this doctrine, as its confirmation and enlargement.

Of the Sugar Plantations in Brasil. From the Breslaw Collection, September 1717. Class IV. Art. VIII. p. 79.

Translated from the HIGH-DUTCH.

Sugar yielded by two different plants, and a great quantity of it in *Brasil*.

BOOTH the *East* and *West-Indies* supply us at this day with sugar, yet from a different plant; in regard that the *East-India* sugar is made from a natural tree, but the *West-India* is taken and manufactur'd from a shrub: The leaves of this last are like those of the wild reed, but the sugar-cane itself has many joints; yet so that the larger these parts are, the sugar-crop is wont to be the richer. Now this sugar-cane grows mostly in *Brasil*, whither the plants were at first carried from the *Canaries*, and to this day have been plentifully propagated there: So that sugar, tobacco and *Brasil* wood are the principal commodities of the *Portuguese* trade to *Brasil*; of this sugar were formerly every year 1,000,000 *Arobba's* (each *Arobba* reckon'd at 32 *Dutch* pounds) imported to *Portugal*, and from thence to the other parts of *Europe*. The principal staple town for sugar is *Olinda* in *Brasil*, from whence sometimes 40 ships laden with sugar have sail'd in one day, and left behind in the warehouses as much as they carried away. This sugar-manufacture is carried on for the most part with slaves or *Negroes* from *Afric*, of which yearly a great number, and in 1621 and the two following years only, 15430 were carried to *Olinda* for the sugar-mills^a: But afterwards by means of the *Portuguese* inquisition, the number of labourers, who pretended to be *Jews*, was greatly diminish'd, and thus the manufacturies were greatly weaken'd: So that this year 1717, there was such a great decay of sugar, that at the close of summer they were advis'd at *Lisbon* from *Bahia de Todos los Santos*, that the sugar plantations were entirely ruin'd, and that this year little sugar was to be expected in *Portugal*, as it accordingly happen'd; for, in the month of *October* there came no more than one single ship with 60 or 70 chests of sugar only, and each chest reckon'd to 20 or 30 *arobba's*, in all about 2170 *arobba's*, with 1986 rolls of tobacco. But at length on the 25th of *November* the whole fleet, consisting of 26 sail, arriv'd at *Lisbon* with 6844
sugar-

^a O. Dapper. *America lib. 2. cap. 4. p. 436.*

sugar-chests and 2864 rolls of tobacco, with 14860 hundred weight of *Brasil* wood, together with other commodities and riches, and with this additional advice, that there was only left behind 5500 chests of sugar, and 7000 rolls of tobacco: So that the remaining ships must have been freighted only with salt. Yet the scarcity of this year was greatly increas'd by a natural cause, seeing the preceeding summer and harvest of *An.* 1716 till *February* this year, that is, for seven long months, there was a great and continu'd drought without any rain all over *Brasil*, whereby the sugar-cane, which requires a great deal of moisture towards its growth, as also the tobacco, were almost entirely parch'd up.

It is well known of this sugar-cane, that it grows as well on unwater'd hills and eminencies as in fat meadows, particularly about *Pharnambuc*, where it usually grows in greatest plenty; yet so that it principally requires a great deal of moisture, but on the contrary, is easily spoil'd and dried up by excessive drought; and the more moisture it has, the better does the cane shoot up and yield the more sugar: Whence the slips of the cane, which are laid in the plough'd field cross-wise, and cover'd with mould, require more earth in summer than in winter, on account of the summer-heat, which otherwise would easily parch up the cane, as it lies shallow: And upon this each joint shoots out a new cane, which in ten or twelve months is ripe and cut off; and the intelligent planters usually set them in the month of *August*, as being the last winter month; and at which time the earth is entirely moisten'd with rain. Now when thus the cane is ripe they cut it off the first year, and also sometimes not till the second year, when it is call'd old cane, in which time it shoots out new canes, which along with the old produce is also gather'd; but what stands above two years till the third year is of little use, and is already quite dried up. In this manner the first planting continues successively without further culture in fat fields for 40 or 50 years: Whereas in dry and poor soils they do not thrive above five years. Now if a continu'd heat and drought come on, the plants are burnt up to the root, and cause great loss to the proprietors; as also on the contrary, from excessive floods the plants are chill'd too much, and in like manner destroy'd: Not to mention, that they are eaten up and destroy'd at the root, especially in marshy fields, by a kind of black wing'd worm, which the *Brasilians* call *guirapea coca*, but the *Portuguese*, *pao de galinha*.

The soil and management for the sugar-cane.

Now after that the cane, which we shall only mention cursorily, is cut, it is clear'd of its leaves, made into bundles, and carried to the mills, where, by means of two thick rollers moving upon each other, the juice is express'd, which in this its first consistence is by the *Spaniards* call'd *caldo*. This, as in 24 hours it becomes sour and unfit to make sugar, is immediately wont to be boil'd in three large coppers, one after another, from the coarser parts, and purified from the scum, call'd *cagassa*, and

The manner how sugar is made.

which is given to cattle; and pouring to it some pretty strong lee, all the impurities are forc'd up to the top, which are skimm'd off with large copper skimmers: After this it is strain'd thro' a linen cloth, and purified from the other remaining recrements, which serve for food to the slaves. From this juice is usually made wine, brandy, vinegar, mead, and lastly, also sugar itself; and this last in the following manner: The juice is boil'd in small shallow coppers to the consistence of a syrup, and here to prevent too great and prejudicial a boiling, a little olive-oil or butter is dropp'd into it; and it is remarkable, that if you pour the said oil into the first larger coppers, wherein the *caldo* is, as also if the lee be pour'd into the last small coppers, as well as into the large ones; or even if some lemon-juice or any other four thing be thrown in, no sugar can be made. Now after this juice is become thick and begins to settle, it is pour'd into wooden moulds, which are brought to a particular bench for that purpose, and done over with moist clay, whereby it happens, that the brownish liquor separates, and thereby the sugar becomes white. Upon this the small hole, which is below in each mould, is open'd, that all the remaining impurities of the sugar may run off. Lastly, this condens'd sugar is taken out of the moulds, the white separated from the black, (which is call'd *mascovado*) dried in the sun, and put into chests. The greatest secret consists in the giving the sugar a beautiful white colour; but this is what the manufacturers will not readily discover. To all this there is requir'd a great deal of pains and charges, particularly a great number of labourers and cattle; so that we may easily see, that besides the excessive drought, the scarcity of labourers occasion'd no small prejudice this year to the sugar-plantations.

I add this remark, that in walking over the fields, one may greatly refresh himself by the generous juice of the broken fresh reed, which tastes like sugar; yet it easily causes, if taken too plentifully, bad *diarrhæa's*: Whence strangers must be caution'd on this account; whereas the inhabitants of the country are not subject to this danger; as all this is fully and circumstantially describ'd by *Guil. Piso*^b, who likewise gives a figure of the sugar-mills; and by *O. Dapper*^c, as also by *De Rochefort* in his description of the *Antilles*^d. But the several species of sugar, the refining and the trade thereof is describ'd by *Marperger* in the *merchant's magazine*^e.

^b *Hist. Nat. & Med. Indiæ lib. 4. cap. 1. p. m. 108.*

^c *America lib. 3. cap. 4. p. 432, seq.*

^d *Part 1. cap. 10. num. 7. p. 174, seq. and Part 2. cap. 5. p. 92.*

^e *Tit. Zucker, p. 1424, seq.*

*A method of bringing up young Children by Hand. From the Acta
Erudit. Lips. An. 1682. p. 197.*

Translated from the L A T I N.

AFTER several other late discoveries about the nutrition of *fetus's* in the *uterus*, there still remains behind the supplying them with a wholesome and always equal food after the birth, and that without the aid of nurses; since such food is but little to be expected from these, on account of their several disorders both of mind and body, and by reason of many other inconveniencies. We are told in the *Journal des Sçavans*^a, that the thing was actually put in practice both in *England* and *Bavaria*, even by persons of the greatest rank, and the method of doing it is there at the same time explain'd: This matter was likewise propos'd in *France* to the overseers of the hospital for foundlings, the greatest part of whom is otherwise lost by bad nursing and the negligence of the nurses: And for this end some were pleas'd to propose *furmety*, others, *pap*, and others again, *hasty-pudding*; till the parliament of *Paris*, Aug. 19, 1680, resolv'd to refer the matter to a certain number of physicians and surgeons, as also to two sworn women, who should communicate to them their opinions. It, therefore, appear'd to these, that tho' nurses are very necessary, so that it were very much to be wish'd, that they might be had for four months at least, to obviate those frequent dangers to which so tender infants are subject; yet that it was no impossible thing to bring up such children without a nurse, tho' the methods above propos'd were only suitable to robust children, and such as were almost fit to be wean'd: But as it is dangerous to try means, not yet confirm'd by experience, and a rash thing to tamper with such delicate bodies, without sufficient reason; and reason does but little favour the means above propos'd, if we only consider the state of newborn infants, their low degree of heat, the weakness of their stomachs, and the liquors dissolving the aliments, almost choak'd up by too much humidity: On these accounts it was entirely necessary, that a nourishment should be substituted instead of the milk of the nurse, that should approach so near to the nature of chyle, as to require little or no heat for its digestion, that should stay but a short time in the stomach, be easily distributed; and above all, in order to avoid any sudden change, which is dangerous to more tender infants, be very similar both to that nourishment with which the mother supplies the infant in the womb and to that supplied by the nurse, instead of which it comes to be us'd: And as these properties are not to be found in *furmety*, which is crude and heavy, and less capable of being alter'd by the weak heat of tender infants, and which undoubtedly would dispose them to fevers or fatal *diarrhæa's*; nor in *hasty-pudding* or *pap*, which are grosser food, and which but very rarely agree with

Whether infants
may be brought
up by hand.

^a *An. 1680. journ. 6.*

new-born infants, and is only fit for children of six or seven months old, when they first begin to breed teeth, that from hence it very evidently follows, that instead of women's milk, that taken from animals is to be receiv'd; as it is evident from history, that several children have been suckl'd by wild beasts; and according to the modern practice, children that have remarkably suffer'd by the small-pox, have with success been put to suck goats. In defect of this method, which is somewhat more difficult, cows milk is to be used, yet with the proper precautions; among which the principal is this, namely, that it be taken by the infants in the way of suction, in which by the motion of the jaws the salivary ducts may be the better open'd, as the mixture of the *saliva* with the aliments does surprisingly promote their dissolution: But that this may be attempted without rashness, reason not only persuades, but the thing has answer'd well even with some of their own friends, as also with several poor women; till by this means the dangers of that first state of life being over, recourse may be had to more solid food, as hasty-pudding, pap, and furmety.

This propos'd to be done by cow milk, and artificial breasts.

These things being thus determin'd, they hint that there still remain three other conditions, highly necessary towards the better success in this matter, to wit, 1. That the milk be of so exact a temperature, as if it came directly from the breasts of a sound woman, seeing the stomachs of children can otherwise less bear it. 2. That it be always kept up to this degree of natural heat. And 3. That it be taken by the child with as much ease, as if it suck'd a good nurse; and for obtaining these requisite conditions, M. du Val, engineer and king's architect, has taken some pains; as to the two first, indeed, he takes a large tinn'd copper vessel, wherein he heats the cows milk to the same degree of heat with that of the milk just drawn from the nurse's breasts; and this temperature is to be determin'd by a physician, by putting a little of each on his hand, and accurately examining them; and that that equal temperature may be always kept up, he externally employs the flame of a lamp with spirits of wine, set under the vessel; but internally he puts into the vessel a thermometer, whose determin'd height is an infallible rule for continuing the same degree of heat in the milk; a figure of which machine may be seen in the *Journal des Sçavans*^b. But the third condition, to wit, the easy suction he fulfills by artificial breasts, contriv'd in imitation of those of a sound nurse, and artificially furnish'd with small tin-tubes, and he frames them of goat's skins, or other limber materials; or, as these are less durable, and on account of their limberness the sooner subject to relax and soften by the sucking of the child, he prefers thin taffety, as being more durable: But that they may always remain turgid, he stuffs them with horse-hair, prepar'd in a peculiar manner; for, thus they will be both soft and tractable, that children may apply their gums to them without receiving any hurt, and by the motion of the jaw the discharge of the *saliva* be at the same time promoted.

A new Method of curing the Gout. By Dr. Conrad Barthold Behrens. From the Miscellanea Berolinensia. Tom I. p. 128.

Translated from the LATIN.

THIS method of curing the gout has happily succeeded for several years together; and the illustrious *Zimmermann* Privy Counsellor to the Emperor, first made use of it, and he has render'd it very famous; so that tho' it be a little tedious, yet other great men by his example have us'd it always with like success, and it is perform'd by a decoction of the woods, as *guaiacum*, *sarsaparilla*, and the root *china*, to which is added a certain quantity of polypody and hermodactyl; and all is boil'd in wine and twice the quantity of water: But it is taken down in large draughts; so that in three days (in which time the cure is always compleated and the patient again walks about) almost 24 pounds of it are drank.

A remedy for the gout.

And this effect succeeding always in all and those even different circumstances, made me that in my *Selecta Medica*, lately publish'd, wherein I have vindicated specific remedies for diseases, I call'd this decoction a specific in the gout.

Being a specific therein.

But this invention is not quite new, since about 200 years ago the physicians of *Genoa* recommended to the Emperor *Charles V.* the root *china*, as an antiarthritic; and from that time decoctions of the woods have been frequently us'd in the gout: Yet the method of using them, as far as I know, is new, seeing the first dose of these decoctions was formerly taken in the morning a-bed which caus'd sweating, but the second at dinner and supper: But here in my cure of the gout the patient even sits up in his chair, then takes it down plentifully every hour, nay every half hour a cup of it, and even at meals. And again he is put into a gentle breathing sweat for three days; and some even have a discharge of urine, and others also an open belly.

How to be taken and its effects.

Nor is this cure without its foundation, seeing by this method, which the weight of the decoction, strongly tinctured with the medicines, does promote, the sharper saline *spicula*, collected in the blood and especially about the joints, and wounding the *periosteum*, ligaments, tendons and nerves, are diluted and plentifully discharg'd out of the mass of blood, and as it were, elixated; and the cure succeeds sooner and with more safety than by antiarthritic tinctures, as they are commonly call'd, as being in too small a quantity, and even than by cathartics or topical applications: For, tho' cathartics may sometimes happen to produce their effect, as a certain nobleman by my direction does now for some years upon the very first attack of the gout always use with the desired success some strong purging pills; yet such cathartics do not promiscuously agree with every body.

The manner of its operation.

as they put the body and blood into a very great ferment, and as they irritate the spirits, and often heighten the pain, and very often on this account protract the paroxysm: Nor is the cure by topical applications always so successful, nor does it seem to me a safe method, whether attempted by repellents, as by these nature is not without danger hinder'd in its operation, and the saline matter more firmly impacted on the joints; or by resolvents and anodyne plaisters for the same reason: For, thus I suppose that *tophi* arise, because the dissolving of the saline matter is by such a method impeded, and that matter thereby collected: So that it is with me a certain truth, that the cure of the gout is best of all perform'd by decoctions of the woods, which are suited to all temperaments and constitutions. When this method began first to be known, there were three objections made to it. 1. That the stomach must be greatly weaken'd by taking down such a large quantity of the decoction. 2. That the weakness of the affected part cannot be so easily corrected, in accomplishing which, nature sometimes takes up some weeks. 3. And lastly, that sometimes notwithstanding this method relapses do ensue. As to the first and second objections experience itself shows their weakness; and except one patient, who after the use of the decoction complain'd for some weeks of a loss of appetite, I know of none other: And yet his loss of appetite was owing to something else too tedious to relate here; and by the use of stomachics his appetite has continued good to this day, and the weakness of the part affected cannot be so great, if the salts be dissolv'd by the decoction, taken immediately on the first onset of the paroxysm, before they weaken the part more and more by a longer delay: For, if this be the case, it is not to be wonder'd at, that some weeks are spent in recovering the part to its tone again; nor do I deny, that relapses may sometimes happen from new causes, but even then the decoction is repeated with a like effect, as I had a remarkable instance of it last year in a certain patient of this place, who about the beginning of spring having kept his bed for several weeks, sometimes by pains in his feet, then in his hands, and again in his arms and shoulders, he at length took the decoction, which at first he could not be prevail'd on to use, and it immediately remov'd the paroxysm, but in a short time after falling into a great passion he had a relapse, with wandering pains in the joints and plentiful night sweats; but he repeated the decoction with success.

This remedy suitable to almost all constitutions.

But whether it may be of service indiscriminately to all patients may be no improper query? But as it is the part of a prudent physician to accommodate his remedies to the temperament and other circumstances of each patient, the same thing is also sometimes to be done by this decoction. And in the first place, I am of opinion, that we are to regard the strength of the *viscera*; yet patients of different ages and temperaments have happily follow'd this method; and even such as seem'd to incline to a consump-

consumption, the stone, a *cachexia* and the scurvy: And very lately a certain nobleman who had a bleeding of the internal hemorrhoids, and who had the gout in his hand, by my advice directly took a draught of the decoction, which he now always uses with success for these two years, as I judged it safer first to dispel the pain before it should be more firmly lodged in the part, by the length of time employ'd in putting a stop to the hemorrhoids, and then the bleeding might also be restrain'd; and if the hemorrhoids should happen to be provok'd by that decoction, that notwithstanding it was better to use it at first than after the hemorrhoids are stopp'd, and they should break out again; and it succeeded well, as the hemorrhoids were no more affected by the use of the decoction, nay rather thereby stopp'd for about a day; and the gout in the hand remitted in less than three days, but the hemorrhoids afterwards disappear'd by an electuary made of detergents and astringents.

Deaf and dumb Persons made to hear and speak. By Dr. Petrus à Castro; together with Observations thereon by Philip Jac. Sachs à Lewenheim. From the Miscellanea Naturæ Curiosorum. An. 1. Dec. 1. Obs. XXXV. p. 112.

Translated from the LATIN.

THERE are many instances of persons of noble families in *Spain*, who were dumb in their infancy, either thro' a natural defect or by accident, as the rumbling of a coach, or the explosions of great guns (for, these causes may occasion dumbness) who afterwards learn'd to pronounce words distinctly; and tho' they always continued deaf, yet not dumb. Such were the son of the Prince of *Savoy*, the Marquis *de Priego* and the Marquis *del Fresno*, brother to the Constable of *Castile*, who were formerly dumb, yet now speak without any difficulty or hesitation, only the deafness is still observ'd. There are many other instances of different private persons, who receiv'd this benefit from *Emanuel Ramiresius de Carione*, which extraordinary secret I learn'd, partly by conversation with the author himself, and partly by dint of close meditation; and it succeeded very well^a; but what he there scruples to discover was perform'd by him in the following manner; the whole business consists in application, dexterity and patience; and *à Castro* himself affirms, that at *Vergana*, a town of *Cantabria*, he in this manner restor'd a boy that was deaf and dumb from his birth, with the greatest assiduity, and tho' it took up some time, and that in two months: So that he could perfectly pronounce his words, and express his thoughts.

In the first place the body is to be purged according to the constitution of the subject, then a special cathartic of black hellebore is to be administered.

^a Petr. à Castro in *Tract. de colostro* cap. 3. p. 18.

Dumb persons taught to speak.

The manner how this is to be perform'd.

nister'd, or the extract thereof exhibited in pills, or one drachm of a decoction of the root. Of this decoction the author took three ounces, in which over night he infus'd two drachms of agaric, and after straining he added two ounces of *syr. de epithym.* The head being purged once or twice by this medicine, as the case requires, the breadth of the head is shav'd above the coronal suture, and then the following liniment is often rubb'd into the shav'd part. *R. aqu. vit. ℥III. salpet. sive nitri purificat. ℥II. ol. amygd. amar. ℥I.* Let them boil together till the spirits of wine are consum'd, then add an ounce of *aq. nymphæ*, and then let it be well mix'd with a *spatula*, and made into a liniment, with which the shav'd part is to be anointed once every day, especially in the evening at bed-time; but in the morning after he has clear'd all the passages of the brain, as the ears, nose and palate, especially by chewing a grain of mastic or a bit of liquorice, or which is better, a lozenge of the juice liquorice, mastic, amber and musk, likewise combing back the hair for several times with an ivory comb, and then washing well the face, he speaks to the dumb person above the shav'd part; and it is surprising that the deaf and dumb person perceives the sound so distinctly, tho' by no means by the ears: If he cannot read you must begin with giving him the letters of the alphabet, and often repeat each one of them, till he himself can pronounce it; and you are to proceed with such industry, that the manner of pronouncing may be gradually instill'd into him, and this you are to continue for several days, till from letters he proceeds to entire words; and let the several common things about the house be shown him, whose names he may learn. Again speak often and much to him, that he may take the manner of joining words: For the first 15 days he surprisingly learns names, which he could not retain without the strongest memory; and every day following the thing becomes easier; and it is surprising with what anxiety he always meditates to break out into words.

Observations
thereon.

Persons dumb from their birth are generally wont to be deaf at the same time; tho' *Dominicus Panarollus*^b has seen a boy of 12 years of age, who indeed was dumb from his birth, but not deaf: Whence being call'd on from behind he would turn about his face, the causes of which the said *Dominicus* assigns, both as the nerves for speech in this lad were at least hurt, as also on account of the different conformation of the nerves, so that the auditory nerve enter'd into the ear alone, and not any where else; and in fine, from his foolishness, on which account he could have learn'd nothing. And thus practical writers alledge a threefold cause, why dumb persons are for the most part deaf at the same time.

Causes of deaf-
ness.

1. By reason of the conjunction of the nerve of the fifth conjugation, the larger branch of which usually runs to the ear, the lesser to the tongue and *larynx*^c.

2. Others

^b *Pentecost. 4. Obs. 17. p. 121.*

^c *Camerar. Cent. 8. Memorabil. Med. § 82.*

2. Others ascribe it to a small cartilaginous canal reaching from the second *meatus*, or the *tympanum* of the ear to the mouth and palate, so that the air passes and repasses freely from the mouth to the ear, and from the ear to the mouth, especially if that *meatus* reaching from the *tympanum* to the palate be naturally large^d. Whence a reason may be assign'd for what *Beubefius* told *Paulus Marguardus Schlegelius*, namely that he knew a deaf woman, who put a horn into her mouth, and desir'd such as would speak to her to apply their mouth to the farther end of the horn, by which means she heard what they spoke, as I some time ago found this in *Schlegelius's* MSS. and saw the account given of it by *Hieronymus Welfelius*^e; for, by means of this canal, string'd musical instruments, held between the teeth and struck upon, do convey a sound thorough the mouth^f; and *Laz. Riverius*^g affirms, that by means of this patent *meatus* it happens, that tho' both ears be stopp'd, if musical instruments be touch'd and held between the teeth, they are heard the more distinctly; and on the high road the tread of a person at a distance is better perceiv'd, provided that one end of a sword be stuck in the ground, and the other end held between the teeth.

3. Others assign this reason for deafness from the birth, as also dumbness, or at the least a difficulty of speech, namely because the minds of deaf persons are not made acquainted with sound, and not knowing how to form these unheard words, they can neither conceive nor express them, seeing speech is only regularly learn'd by hearing other people talk. To this opinion inclines *Franc. Mercur. Helmont*^h. Such as labour under this misfortune, namely want of speech, are for the most part, properly speaking, only deaf; for, they are not depriv'd of voice, nor of the motion of the mouth and tongue; but the want of speech arises hence, namely that their organs of hearing being vitiated, they cannot hear others speak; consequently they cannot form by the motions of their tongue and voice the ordinary distinctions of human sounds, according to the common method of speaking. Upon this principle *Petrus Pontius*, a *Benedictine* monk, taught persons born dumb to speak by no other art than first teaching them to write down the names of things, and then pointing to the things that answer'd to the characters, according to *Franciscus Vallesius*ⁱ testimony.

Franc. Mercur. Helmont^k has disclos'd the method of restoring speech to the dumb and deaf, which hitherto has been a secret, and it is founded upon the following principles.

The principles on which this method is founded.

1. Such as are thus deaf are for the most part very sharp sighted: so that if one talk to such people about domestic affairs, they very readily

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U

and

^d Vessling. *Syntagm. anat.* c. 16.

^e *Episagmat. Obs. Med.* 24. p. 16.

^f *Camerar.*

Cent. 2. mem. § 71.

^g *L. III. prax.* c. 1. p. 187.

^h *In alphabet. Natural.*

Hebraico Colloq. I. p. 1.

ⁱ *In philos. sacra.* c. 3. p. 57.

^k *L. a. colloq.* 1.

and even at a distance understand what is said, as if they read the words, and that only by a somewhat more accurate observation of the speakers mouth, as we have it confirm'd by the histories that shall be mentioned anon.

2. They learn in the same manner, that illiterate persons first learn to read; for, as these at first make use of larger characters, and afterwards proceed to smaller ones, and even to abbreviations, which they very easily attain to, tho' some things are not fully express'd till the end of the sentence: Thus such deaf persons seem at first to observe more exactly those, who with a loud voice order some thing to be brought them; and taking a more particular notice of their tongue, lips, cheeks, chin, throat, &c. as also of their different motions and changes, they make use of these, as of the larger characters, in order to obtain the sense of the speakers, and being confirm'd in these, they seem to proceed to the more gentle and ordinary motions of the speakers, till at length they understand their meaning from the first commencing of these motions; tho' the whole be not yet compleated, more especially when assisted therein by custom. The principles therefore, by which such deaf persons understand, are the different motions in the tongue of the speaker; from which, as from the first elements of writing, they understand his true meaning.

3. After having thus understood words, *Helmont* thinks it no difficult matter for them likewise to read writing readily, if the letters be depicted to them in the same manner they saw them form'd by the tongue of the speaker, and they may be brought to the use of speech, if any one would teach them before a looking-glass to imitate with their own mouth these very motions, and afterwards animate them, as it were, with a strong breath.

4. The same *Helmont*¹ asserts, that this succeeds better in the oriental languages; for, the eastern people on account of their warmth require a fuller breath; whence they speak with open mouth and wide throat, that any one may very easily observe the motion of the tongue; but in *England* and places more northerly the mouth is open'd but little, and they scarce move the lips.

Instances of the
success of this me-
thod.

Helmont^m, therefore, testifies, that he made an experiment on a deaf musician, whom he brought so far in three weeks time, as to answer any question ask'd himself slowly and with open mouth; and in a short time after he learn'd the *Hebrew* by himself. What *Helmont* perform'd in the *Hebrew*, Dr. *Wallis* of *Oxford* did a few years ago perform in the *English*, teaching deaf, nay dumb persons to speak, and that in two instances: And *Olaus Borrichius* in a letter to *Bartholin* from *London*, dated *August* 10, 1663ⁿ speaks of it thus; 'I saw, says he, a young gentleman with
Dr.

¹ *l. a. p. 3.*

^m *l. a. p. 5.*

ⁿ *Cent. IV. epist. 92. p. 527.*

Dr. Wallis, who, I know not by what misfortune, became deaf in the fifth year of his age, and dumb in six months after; and now for 20 years he could not speak a word. Dr. Wallis writes down on paper the letters and syllables, then he repeats them himself, causing the other to make the same motions with his tongue; nor was the Dr. disappointed in his thoughts; for, he has now brought the young man so far, that he can pronounce some things pretty distinctly, tho' he still continue deaf. Monconys^o also gives an account, that when he was at Oxford in June 1663, he saw at Dr. Wallis' house, a young gentleman both deaf and dumb from his birth, whom the Dr. taught to read; that he read just like any other person, only with this difference, that he pronounced but one syllable at a time; and that this was the second person on whom the Dr's experiment had succeeded. Dr. Holder has lately publish'd a dissertation on the elements of speech, in order to shew how deaf and dumb persons may be taught to speak, of which you may see more in the *Philosophical Transactions* of the Royal Society at London^p.

What these dumb and deaf persons have acquir'd by the industry of a master, other deaf persons have by mere instinct, and from a great fondness to learn, attained by the motion of the lips, yet still continuing deaf. Borellus^a gives an account of a sailor, who from the fifth year of his age became deaf by a violent distemper, and together with it had a difficulty of speech; he hears people speak, tho' they mutter only, can understand what they say, and answer questions put to him. Nicholas Tulpius^r makes mention of Simeon Dietericus, a Dutchman, who became deaf by a fall from the tower of Purmerendan; and that he understood what was said from the bare motion of the lips of the speakers, and as their lips happen'd to be smooth or rough, thinner or thicker, he understood their meaning better or worse. At Saltzborn in Silesia liv'd a scrivener, who after the small-pox became deaf, he had a natural bent to mathematics; so that he learn'd by himself the art of painting and mixing colours. He understood such as only whisper'd better than those who spoke aloud, and all this by the motion of the tongue and lips of the speaker, which he view'd very attentively, and made pertinent answers.

This attain'd by the motion of the speaker's lips without a teacher.

For such as are not quite deaf human skill has discover'd an excellent contrivance. We are told of Job. Baptista Lallius Nursinus, a lawyer and poet, that having begun to lose his hearing at 40 years of age, he was oblig'd to make use of a small silver tube, which he applied to his ears for receiving the words spoke to him^t. And a like instrument the Spaniards at this day make of silver or copper, and they call it *farbatana*; and if they have any defect in their hearing, they carry it about with them as other people do spectacles. It is said to be like a funnel, whose wider part is turn'd

An instrument for helping deafness.

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^o Voyag. d'Angl. Tom. II. p. 50.
^t Lib. 4. c. 18.

^p Num. 47. p. 958.

^a Cent. IV. Obs. 33.

^r Nicii Pinacothec. part 1. imagin. 73. p. m. 131. Ed. Colon.

turn'd towards the person that speaks, and the narrower end applied to the deaf person's own ear.

An instrument to
help stammering.

For such as stammer chance has also discover'd an instrument, and art has perfected it in a man, who, having a part of his tongue cut out, could not speak so distinctly, and it is describ'd and delineated by *Paræus*: It is a piece of rounded wood, which is held between the incisors; so as not to stand out of the mouth; its inferior and thinner part is closely applied to the membranous ligament under the tongue; it is internally somewhat hollow, and as often as it is properly fix'd in the mouth, the person speaks distinctly, so as to be understood by every body. I know a very curious and learned man, who taught a young gentleman of the family of *Falckenbain* in *Silesia* to speak distinctly, and that in a few months; and he shew'd from the nature of the oriental languages, how from the diversity of the letters, as some are guttural, others labial, others dental, and others lingual, the instruments of speech may be diversely mov'd and inflected, by not only shewing the young man those motions exactly in himself, but likewise often inflecting his tongue and lips, till he learn'd perfectly to express the words. At *Saumur* in *France*, a certain person lost his tongue by the small-pox, and yet he could readily talk; he could not, it is true, exactly pronounce some of the letters; but such of them, as are pronounc'd without the motion of the tongue, and which are form'd by the throat, as A, or by the lips as B, to better advantage^u. *Jac. Rolandus*, a surgeon of *Saumur*, on account of this extraordinary case, publish'd a treatise, entitul'd *aglossostomagraphia*, or a mouth without a tongue that speaks perfectly, wherein mention is made of an extraordinary case of a person of the *Lower Poictou*, who, when a boy of five years old, lost all his tongue by the small-pox; and yet he could perform all the five functions ascrib'd to this part, as speaking, spitting, tasting, and chewing, as also swallowing, to the admiration of every body.

Engastromythi
what? And their
impostures.

In fine, some people pretend to be dumb, and they seem at least to speak from their belly, and they are denominated *engastromythi*, or *ventriloqui*: Of these *Digby*^w speaks thus; 'such as are call'd *ventriloqui* impose on ignorant people, persuading them, that some demon or other emits sounds from their belly; by a peculiar art they draw in their breath, whereby it happens, that the words seem not to proceed from themselves, but from something within them, tho' they seem at least to come from them; for, if you do not advert to it, you will imagine they proceed from some distant place.' And *Job. Walæus*, formerly professor at *Leyden*, saw such a person in *France*^x. *Fr. Mercurius Helmont*^y affirms that it is done by means of the *epiglottis*, which, like a clack in a pair of bellows,

^u *Cbirurg. lib. 22. cap. 5. f. 489.*

^w *De nat. corpor. tr. 1. c. 28. p. 319.*

ib. 12. § 2.

^x *Thom. Bartholin. Cent. II. hist. rar. 22.*

^y *Alb. Kyperus in institut. physc. lib. 10. cap. 2.*

Alph. Hebraicum cap. 3. p. 22.

bellows, covers and closes the beginning of the *aspera arteria*, and by drawing the breath inwards into the belly and shutting close the mouth; as some impostors in our days pretend to prophesy, which *Helmont* himself understood from undoubted experience.

Of the separation of salt and fresh Water, and a new kind of chemical Separation. By G. G. L. From the *Acta Eruditorum* Lips. An. 1682. p. 386.

Translated from the LATIN.

THE separating of fresh water and the salt contain'd therein may be done with a twofold view; either we want fresh water, without minding the salt, for the use of sea-faring people; or on the contrary, we want the salt and neglect the fresh water, in order to lessen the expence of fire, by means of which the water evaporates; a thing that would be of no small service in those parts where the sun has not sufficient force for this purpose.

The separation of salt and fresh water twofold.

As to the first, it is plain not only from the account of *Linschotten* but of a great many others, that pretty good fresh water to drink may by distillation be got from sea-water: And I should think that for that purpose very compendious furnaces might be contriv'd, that would require but little fuel, and such as are not hitherto us'd. I know that salt may be precipitated by zink, *lapis calaminaris*, &c. nay lead is of some service in this case. But the most simple way of obtaining fresh water I take to be by filtration; for, it appears by experiments, that even wine, urine, and other liquors lose not only their colour but their taste, by repeated filtrations thro' simple sand. And when in *France* I saw a kind of stone, which by once filtering made the liquors insipid. And that salt water may be the more easily strain'd thro' a larger quantity of sand, and so be made fresh by one, or at most two filtrations, a compressing or sucking engine might be us'd. But if any one would incline to use litharge, or any other *calx* of lead, instead of simple sand, the thing would probably answer still better. Moreover, from these things I got the hint of a new kind of chemical separation: Let us suppose, that a liquor is often filtered thro' common or a particular sort of sand, or any other body, till it become insipid, there is no doubt but the sand must be impregnated with some essential salt of the liquor. Let that salt be again extracted from the sand, by pouring common water thereon, and afterwards evaporating part of the water, and let it concrete into crystals, or in some other way be reduced to dryness. But lest any one should imagine, that it is needless to restore to the salt, which is to be extracted from the sand, the water we before separated therefrom.

The first done by filtration.

by

by filtering, he must observe, that by this means a large quantity of salt, which before was dispers'd in a large quantity of liquor, is now concentrated into so small a quantity thereof, as is sufficient to dissolve it; and that then there is a deal of difference between the first water, which is naturally in wine or any other liquor, that would not so easily have let go this cognate salt, and between common water now pour'd upon it, which as it at first attracted this essential salt, does immediately freely let it go. If any one, omitting elixation, would fain try what would be got by distilling the salt from the sand, or by the vitrification of the sand, he, no doubt, would make a great many new discoveries, and likewise, probably, produce some peculiar earths. Thus, by means of this subtil filtration, we shall have a new analysis of several bodies, and a great deal of matter for useful experiments.

The second separation by simple motion.

It remains to treat of the second head, namely the separating the salt from the water, without regarding the water. This separation may be several ways render'd easier, some of which we have already mention'd; for, even those compendious furnaces will evaporate the water with less charges; and then if the salt left behind in the sand be had by straining, it will be concentrated by elixation into a water much richer than the former, consequently more easily boil'd in. But not to mention at present the influence of the sun and air which has not been sufficiently applied, it will suffice to mention in what manner the water can be separated by simple motion without any fire. I had the hint of this thought from those salt-works, call'd *leck-wercke*, where a great part of the wild or heterogeneous water, which is mix'd with the brine, is dissipated by motion and by falling down: But I thought the operation might be improv'd, when I consider'd those well known bellows that work by means of the wind generated by the fall of water. For, hence it manifestly follows, that if salt water, falling down once and being rais'd up again by means of an engine, should fall down a second time, that at length, when all the water was evaporated, the salt alone would remain behind at the bottom.

Some new experiments made in Silesia, on the encreasing or multiplying of Corn. From the Breslaw Collection, September 1717. Class, V. Artic. VII. p. 110.

Translated from the HIGH-DUTCH.

Improvements in vegetation.

SCARCE ever did mankind apply themselves more assiduouly to exalt the powers of vegetables, than they have done of late years, by several new experiments, contriv'd, partly to improve, and partly, and that chiefly, to multiply their produce: And to this purpose the following ones were made in *Silesia*.

1. In farms,^a where dunghills lie exposed to the open air and rains, let the dark brown water, which runs from them, be saved in proper vessels, to be set in pits, dug near the dunghills: This water is the best substance of the dung, and supplies vegetables with their most perfect nutritious juices; tho' generally it is suffer'd to run off to waste and soak into the ground. 2. Collect human urine, and let it be brought to putrefaction, particularly by a previous evaporation at the fire. 3. Let both be mix'd together, and made to digest and ferment in a copper by the fire. 4. Into this liquor shoot the grain, and let it soak therein for four days and four nights. 5. And then sow it: And thus it will not only yield a much richer crop, but the field will never require dunging or fallowing.

Experiment I.

Half a peck of wheat, being steep'd for 48 hours in bullock's blood, then dried, and thin sown, grew up into large tufts of corn-stalks.

Experiment II.

This third experiment,^b which is Dr. *Hermann's*, consists in the following particulars: 1. At seed-time, either in spring or harvest, make a proper lee, as half a quarter *Breslaw* measure (or about half a peck, *English*) to each bushel of corn. 2. Take half a quarter of sheep-dung, either boil'd with the lee, or exprest into it. 3. Dissolve therein three or four pounds of saltpetre. 4. Throw into this liquor a bushel of clean fresh corn. 5. Let the corn soak therein for eight hours. 6. Set the seed to dry in an airy loft, and where there is but little sun. 7. Repeat this operation once more: And lastly sow it; and in three days it spires. In this manner the poorest and most sandy soils answer well; but they must be thin sown: Besides, they require no dunging; so that this method is very advantageous, where there are few cattle, and little dung made: And you need only sow half the quantity you otherwise would; and often one grain yields 10, 12, and more stalks.

Experiment III.

The success of this experiment, *An.* 1715, was, that one bushel of corn, manag'd in this manner, and sown on poor land, yielded $8\frac{3}{4}$ bushels, which was an extraordinary increase: Besides, the corn order'd in this manner is not apt to smut or mildew.

Success of the Experiment.

Professor *Le Mort* communicated the following vegetable liquor:

Take flower of meal and lintseed, from which the oil has been exprest, 10 pound, horse-hoof shavings 20 pound, wood ashes 40 pound, quicklime 10 pound, stale human dung 80 pound, dregs of lintseed oil 15 pound, a sufficient quantity of urine, to make all of the consistence of a gruel. In the month of *October* let these ingredients be mix'd together in a cask, and let them stand all the winter, stirring them every day with a stick, that being perfectly mix'd, their intestine motion may be kept up: To one part of the above composition take 150 parts of *March* rain-water for steeping your seeds. This experiment may be of service, but as it is too troublesome and laborious, the following may be substituted for it.

Take

A liquor to promote vegetation. Experiment IV.

^a Casp. Schröeders *Feld-Bau*, Part II. c. 2. p. 94, seq.

^b *Agricolæ Versuch der*

Universal-bermehrung aller bayne, &c. Part I. sect. 1. c. 2. p. 11, 12.

Experiment V.

Take *sal gemma* 10 pound, quick-lime five pound, calcine them in a potter's furnace, and then mix them with stale dung; let them stand summer and winter under cover; sprinkle them often with human urine: Then take, for instance, 20 pound of this matter, common ashes 10 pound, and mix them together in a pail of rain-water.

Success of the Experiment.

Upon steeping in the above liquor one bushel of wheat, and sowing it in a field, that had been sown three years running, it yielded five bushels; $1\frac{1}{2}$ bushel of oats, steep'd in the said liquor, yielded 10 bushels. Garden seeds, thus steep'd, do not answer in *Silesia*, but are readily kill'd by the frost: The best way is to water these carefully with this liquor as soon as they chit. Fruit becomes larger and better tasted by such watering; and the trees themselves thrive better: But I have observ'd, that if the sprinkling be omitted the following year, the fruit degenerates.

Experiment VI.

A dry, sandy and barren field being sprinkled *An.* 1715 with potash; for the first year three bushels of barley yielded 18; and upon sowing wheat therein the following year, *viz.* 1716, the crop proved still richer: And such fields require no improvement for many years after: Soap-boilers ashes, which were formerly thrown away as useless, are now employ'd in *Silesia* to advantage on dry soils. We shall only mention, that there is suppos'd to be an extraordinary virtue in the putrefied parts of animals, as appears from *Vallemont's*^c noted composition of the water, prepar'd by putrefaction from bones, leather-shavings, horns, hoofs, &c. As also that at this time about *Bresslaw* comb-makers shavings are employ'd to good purpose. In what manner the seed vegetates with the foul water from bare horse-dung without straw, and how it may be sown to great advantage with chopped straw; and how in *England*, by means of sea-water, or the ashes of plants, mixed with sea-sand, such experiments may be made with profit, may be seen in the *Miscellanea Naturæ Curiosorum*^d; as also in a dissertation at *Wittemberg* *An.* 1695, entitul'd *de Pane Lucrando*.

Different soils require different treatment.

But in all these experiments, the different qualities of the soils are to be regarded; for, some require the saline, others the sulphureous principle, and others again want fallowing, &c. for their improvement.

^c *Curiositez de la nature*, p. 157, seq.^d Dec. 1. Ann. 2. Obs. 112. p. 185, seq.

Of the Origin and ancient Seat of the Scythians. By Theophilus Sigefridus Bayerus. From the Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 385.

Translated from the LATIN.

The design of this dissertation.

THAT every one may know at the first what my opinion is about the *Scythians*, I enter a caveat, that I by no means derive from them the *Sarmatians*, *Russians* and *Sclavonic* nations, nor the ancient *Hunni* and the modern *Hungarians*; nor in fine, the *Tartars*; but the *Lithuanians* and

and the ancient inhabitants of *Prussia*, as also the *Courlanders*, *Livonians*, *Aestii*, *Finns* and *Laplanders*, and some others. So open a confession will stick in the minds of the readers, till in the progress of this dissertation, they find it gradually establish'd by me. As I allow not the *Russians* to be the supposititious offspring of the *Scythians*, I reap this advantage, namely that I do not suffer their original to be confounded, and an other-wise noble people to be ingrafted on a foreign stock: And I at the same time gain this farther advantage, that as to that country, which was anciently ennobled by the *Scythian* name, and is now an accession to the large Empire of *Russia*, by enquiring into antiquity I extract, or as it were, express what either may be true or very nearly so; not to mention, that I may be assisting to those, who, in tracing the origins of the *Hungarians*, *Poles*, *Tartars*, *Turks*, and other nations, being driven, as it were, by stress of weather to the *Scythians*, anchor there as in a place of safety.

For, such as have treated before us of the *Scythian* affairs: have been involv'd in one remarkable great error, against which if we do not provide, we lose all our labour and pains in restoring the antiquity of that nation, and corrupt the origin of many other people. I might quote many great men, did I not chuse rather to draw a vail over their mistakes, and not to mention men, from whom we daily reap advantage in other things, than to triumph over them upon this account; for, they extend the name of *Scythians* to vast tracts of land, almost from the rise of the *Danube* and from the *Weissel* and *Baltic* sea along the northern ocean, the *Euxine* and *Caspian* seas, as far as the outmost parts of the east. Ancient writers have likewise gone before them in this error, and were a cause of stumbling to the moderns. *Ephorus* is the first of them so far as we know, who in his fourth book of histories has divided the earth among the *Scythians*, *Indians*, *Ethiopians* and *Celtæ*. *Cosmas Indicopleustes* has preserv'd in his *Topographia Christiana* a fragment of that passage^a. I am not ignorant, that *Diodorus Siculus*^b objects to *Ephorus* his negligence of truth, and, as it were, a kind of stupidity: But I would incline to judge very favourably of him, since his histories are now lost; so that we cannot form a judgment of them: I, therefore, find, that *Ephorus*, when he would class under certain heads and explain the position of places, has applied the names of the more remarkable nations to the larger tracts with no bad design but unhappily; for, whatever *Ephorus* writ was taken by most of the *Greeks* and *Romans* for certainties; and thus the error spread among posterity: And, therefore, so many nations and those of different original, not only confin'd within the limits of one common country, had all the common name of *Scythians* given them by these authors, but even from that appellation of the country they were made one and the same people; and thus the history of the *Cimmerii* is confounded with that of the *Scythians*, the *Scythian* history with that

The mistakes of authors as to the *Scythians*.

that of the *Sarmatians*, *Russians*, *Huns* and *Tartars*; and there are some who confound not only the countries, but even the periods; for, whatever names of these countries or people they find among the writers of any age, these they apply in their geographical descriptions: We are, therefore, to be careful, that we do not justly incur the same reprehension; and that no one deprive us of this just defence, namely, that we would not advance any thing without just grounds, and publish uncertainties for certainties.

*Scythians whether
the posterity of
Magog.*

Most authors relate, that the *Scythians* are descended from *Magog*, the son of *Japhet*; among whom *Samuel Bochart* claims the principal place. There is no author of this opinion of greater antiquity than *Josephus*^c, who indeed mentions the *Scythians* by name; but he seems to have taken this from *Ezekiel*^d, who places the country of *Magog* to the north of mount *Caucasus*, between the *Tanais* and *Volga*: But the same *Ezekiel*, when he calls the *Scythians* *Gog in the Land of Magog*, shews pretty evidently, that another people, *Magog*, inhabited those parts before the irruption of the *Scythians*, which have still retain'd their ancient name among the *Asiatics*. *Ezekiel* is, therefore, so far from deriving the *Scythians* from *Magog*, that he even opposes this opinion. Others also ingraft the *Turks* and *Tartars* on the stock of *Magog*, whom *Ezekiel* had call'd *Magog* from their *Aborigines*, as it were; I therefore think, that the first progenitors of the *Scythians* are not known; yet this I think I have gather'd from no mean arguments, that the ancestors of the *Scythians* probably came from *Armenia* to the south, and then proceeded to the north-east, till they settled to the north of the *Caspian* sea, being urg'd on by other succeeding families: And from that time I find they dwelt to the north of the *Caspian* sea, and on the *Volga* near the *Massagetæ* and *Issedones*. The *Scythians* themselves have related in *Herodotus*^e, that they were 1000 years older than *Darius'* expedition. The *Scythians* have foisted into this place a fable, namely that *Targitaus*, the father of the *Scythians*, and son of *Jupiter*, by a daughter of the river *Borysthenes*, had three sons, whose names are *Leipoxais*, *Arpoxais*, and the youngest *Colaxais*: *Colaxais* obtain'd the empire by a divine prodigy, from whom is descended the noblest family among the *Scythians*, namely, that of the kings, which are call'd *Paralatæ*; from *Leipoxais*, the *Auchatæ*, and from *Arpoxais* the *Catteari* and the *Traspies*. *Colaxais* again divided the nation among three sons; and all of them call themselves *Scoloti*, which is the surname of the kings. They are only call'd *Scythæ* by the *Greeks*, as *Herodotus* plainly hints: But the name proceeded hence, namely that the *Greeks*, who liv'd among them in the colonies of *Pontus*, observing their great dexterity in shooting arrows, and hearing archers call'd *Scythians* by them, gave that name to the whole nation, and the term still remains in languages of *Scythian* origin: and at this day among the

^c Antiq. Jud. lib. 1. c. 7.

^d c. 38. 39.

^e lib. 4. c. 7. Ed. Gron.

the *Lithuanians*, *Szauti* denotes both to shoot with the bow, as also an archer, from which in *Constantinus Szyruidus*, *Szaudu* signifies to shoot with bow and arrow, and *Szaudikie*, an arrow or dart: And among the *Finns* and *Livonians*, as also the *Courlanders*, *Aestii* and *Laplanders*, *Skytta* and *Kytta* or *Kyt*, signifies an archer: And in fine, among the ancient *Pruteni*, as *Prætorius* informs us in his *Orbis Gothicus*, it was call'd *Szythi*; and it also pass'd into the languages of other people of a different original; and among the *Greek* writers the name *Scythæ* became more famous than that of *Scoloti*, their true but obscure name: Yet the name of *Scoloti* continued among the *Athenians* as a term of reproach; for, the publick servants and watchmen at *Athens* were call'd *Τολοται*, as also *Σκυθαι* and *Τοξοται* (*Tolotæ* corrupted from *Scoloti*) as also *Scythæ*, because they were archers and liv'd in the middle of the *forum* under skins. Thus among the *Romans*, by way of contempt, their slaves had their names, as *Pbryx*, *Dacus*, *Syrus*, and *Geta* from these several nations.

I think proper to enquire what truth may seem to be in this account of the *Scythians* in *Herodotus*: for my part I am far from despising such ancient monuments of nations; and probably, the reason why *Herodotus* imagin'd, that *Targitaus* was the son of *Jupiter* by the daughter of *Borysthenes*, was, that one *Pappæus* was his father (for, the *Scythians* call'd their supreme God *Pappæus*, and *Herodotus* thought it was his *Jupiter*) and his mother a *Cimmerian* on the *Borysthenes* and descended of the royal family. Under *Targitaus* the *Scythians* united into one body and commonwealth; and afterwards were divided into three tribes among his three sons: And most people have trac'd their origin from the first establishment of their commonwealth, or from some remarkable revolution. The *Chaldeans* told *Callisthenes*, as he enquir'd about their antiquity, a number of 1903 years, according to *Porphyrius* in *Simplicius de cælo*: From whence we gather, that the *Chaldeans* fixt the original of their nation later than the flood by 115 years, from the time they became a republic: As therefore, the *Scythians* give out, that they were 1000 years before *Darius'* expedition, they disclose to us the beginning of their republic. If we place *Darius'* expedition before the year 4200 of the *Julian* period, the *Scythian* history takes its rise about the year 3200 or 1514 years before the *Dionysian* *Æra*, about the latter end of the *Jewish* captivity in *Egypt*.

As to the ancient country of the *Scythians*, *Herodotus** was thus inform'd, that the *Scythians* were *Nomadæ*, and liv'd up and down in huts, in places fit for pasture beyond the *Araxes*, and that being driven from hence by the *Massagetæ*, they made war on the *Cimmerii*, who dwelt on the *South Sea*, or the *Pontus Euxinus*. To these he adds, as but little consonant, from the *Arimaspea* of *Aristæas Proconnesius*, that the *Arimaspi* drove out the *Iffedones*, the *Iffedones* the *Scythians*, that the *Scythians* could not defend themselves, but by giving way to such troublesome neighbours; and therefore, invaded the country

country of the *Cimmerii*. But *Herodotus* remarks^f, ‘ that *Aristeas* does not agree with the *Scythians*, as to the country they first inhabited:’ But we may ask, wherein do they differ? The *Scythians* say, that they originally dwelt beyond the *Araxes*, but *Aristeas* near the *Iffedones*, that is, to the east of the *Caspian* sea: The case is this, *Herodotus* was ignorant of the *Araxes* meant by the *Scythians*, and thought that it was in *Media* *ἐν Μαιτινῶν*^g, which is a province to the south bordering on the *Armenians*^h; but that *Araxes* is however very far from the *Iffedones* and the east: But *Herodotus* was not aware, that from this river the *Scythians* could not pour in into the country of the *Cimmerii*; for, what a great way about must it be? if the *Scythians*, opening a way thorough the provinces of *Media*; and passing the *Araxes*, had made irruptions into the country of the *Cimmerii*, and from hence pursuing the enemy and being deceiv’d by them in their flight, thro’ a mistake of the way, had upon their return unawares fallen into *Media* the same way they came: And *Herodotus* seems to be appriz’d of this objection. Heⁱ, therefore, calls the country from the *Danube* to *Cercinitis*, ancient *Scythia*, as if the ancestors of the *Scythians* had remov’d from that country thro’ the *Thracian Bosphorus* into the *Lesser* and *Upper Asia*, and passing the *Araxes* thro’ mount *Caucasus* came into the country of the *Cimmerii*: And whether in this, or in any other manner the matter is order’d by *Herodotus*, he is on all hands involv’d in difficulties.

The Author’s
opinion.

To speak my own mind, I shall not so much regard *Herodotus*, as those whose testimony he uses; and they said, that the *Scythians* liv’d beyond the *Araxes* near the *Iffedones* and *Massagetæ*; and that, the *Scythians* being driven out, the *Massagetæ* possess’d the parts beyond the *Araxes*^k to the east of the *Caspian* sea, overagainst the *Iffedones*, where the country extends itself into a very wide plain^l; and they said that that *Araxes* vied with the *Danube* in bigness, and had many islands in its mouth, as big as *Lesbos*: None of these things agree to the *Araxes* of *Media*; neither the situation of the *Massagetæ*, nor the bigness of the river, nor so many, and so large islands in its mouth; but all these things agree to the *Volga*: The ancient *Massagetæ* were to the east, the length of the river is one third greater than that of the *Danube*; its mouths are 80 and upwards, which contain large islands^m. What *Herodotus* says, ‘ that the *Araxes* is said to be both greater and smaller than the *Danube*,’ likewise confirms, that he heard speak of two rivers, one of which, to wit, the *Volga* greater than the *Danube*, and the other, which is now call’d *Rus*, the smaller; and I am pretty certain that in ancient times the *Volga* was call’d *Araxes*, or *Rus*, *Ros* and *Rbas*. *Onomacritus*, and the uncertain author of the *Periplus Ponti Euxini* affirm, that the *Tanais* disembogues from the *Araxes* into the *Palus Mæotis*; *Aristotle* likewise.

^f Lib. 4. c. 13. ^g Lib. 1. c. 202. or rather *Μαιτινῶν*, as *Gronovius* has rightly published it. ^h Lib. 5. c. 48. ⁱ Lib. 4. c. 99. ^k Lib. 1. c. 201. ^l Lib. 1. c. 202.

^m Nic. 1. Visserius *Noord en oost Tartarye* f. 700.

likewise in his meteorologyⁿ has authorities, that from *Parnafus* (he intended *Paropamisus*) the largest mountain to the north-east, the *Bactrius*, *Choaspes*, and *Araxes* flow: ‘From this *Araxes*, says he, the *Tanais* being divided (for it is a part thereof) discharges itself into the *Palus Maotis*.’ The mistake arose from the vicinity of the *Tanais* and *Araxes*. To this we add *Agathemerus*, who writes, that the *Iaxartes*, *Oxus*, *Rhymnus*, *Rhos* (which is the *Araxes* of *Media*) *Cyrus* (which is the *Kur* mixing itself with this *Araxes*) and in fine, that the *Araxes* disembogue into the *Caspian* sea. Every one plainly sees, that from the east he passes along the *Caspian* coast, till at the north he end at the *Volga*: But *Ptolemy* calls the *Volga*, *Rba*, a term still frequently used by the *Russians*; so that it could not be obliterated by length of time, and the surprising revolutions of nations.

Among other things *Ptolemy* speaks thus; ‘there is another mouth of the *Rba* near that of the *Tanais*.’ *Vossius* on *Mela* corrects the expression *ἐκβολή* into *ἐπιστροφή*; but *Ptolemy* is to be left in his mistake, who thought, that the *Volga* and *Tanais* mix’d, and that the eastern channel of the *Volga* disembogu’d into the *Caspian* sea, but the western into the *Tanais*: *Pomponius Mela*^a also mentions two mouths of this river, but in the *Caspian* sea only, ‘many large and small rivers, says he, run into the *Caspian* sea; but the most noted, call’d *Rba*, comes down in one channel from the *Montes Ceraunii*, and in two channels enters into the *Caspian* sea.’ *Ammianus Marcellinus*^r says, ‘near this *Tanais* is the *Rba*, a river on whose banks a certain root grows of the same name, of various uses in physic.’ I take it that he speaks of the *Rhabarbarum*; and it seems that that name *Rhos* and *Rba*, and the like, was deriv’d from the ancient and common language of mankind, to the *Scythians* and other nations, by which they express’d a river. Among the *Arabs* it is *Roba*; among the *Turks* and *Persians*, *Fud*; and among the *Russians*, *Reca*, and among the *Greeks* *PEIN*; and perhaps *Rbcnus*, *Rhodanus*, *Rhaduna* at *Dantzick*, as also *Eridanus* or *Rbudon* of *Ptolemy* and *Marcianus Heracleotes* (now *Duna* at *Riga*) and *Russa* in *Prussia*, which are all appellations of a river, are no other than remains of the ancient language: And hither is referable *Eris*, a river mention’d by *Lycophron*^r, when *Cassandra* says, that the *Amazons* left the *Eris*, *Lagmus*, *Telamus* and the *Thermodon*, and invaded the *Athenians*: And *Johannes Tzetzes* makes them to be rivers of *Scythia*. From the vicinity of the *Thermodon* we learn, that the *Eris* was in *Pontus*. *Xenophon*^r calls it *Iris*, and from him also probably *Pliny*. There were two rivers in *Mesopotamia* call’d *Roba* by the *Arabs*, which denotes rivers; the one at *Edeffa*, which the *Macedonian* colony call’d *Scirtus*; the other lower than it, which is call’d by *Ptolemy* and.

ⁿ Lib. 1. c. 13. ^o p. 235. Ed. Gron. ^p *Ἐστὶ καὶ ἕτερα τῆ Ρᾶ ποταμῷ ἐκβολὴ πλη-*
σιαῖσα τῇ τῇ Ταναΐδῳ. ^q Lib. 3. c. 9. ^r Lib. 22. c. 16. ^s v. 1333. ^t *ἐκ.*
Δαζασσι lib. 5. c. 6.

and at this day by the *Arabs*, *Chaboras*, of which the *Greeks* made *καλλιρρη*, as I have shewn in the history of *Edeffa*: And of this *Xenophon* himself made *Araxes*, different from that in *Media*, which *Xenophon* did not mention: And afterwards the name *Araxes* remain'd corrupted; for, an *Arabian* geographer, which *Joseph Scaliger*^u examin'd, says, that the town *Carcesia* is wash'd by the river *Al Harias*, call'd *Al Chabor*. *Harias* is from the *Araxes* of the *Greeks* in *Mesopotamia*, and *Araxes* from *Roba*. So nice were *Greek* ears, that they could not bear barbarous sounds; and therefore, they either fram'd from their own language new names of nations, places, and men; or they so adapted the barbarous words to a *Greek* mouth and ear, that scarce any trace remain'd of their origin. Of this custom *Plato* has a dispute in his *Cratylus*; and in his *Timæus* he could not retain the words of the *Atlantic* language, unless they were pronounc'd after the *Greek* manner: But this itch of pronounciation was uncertain and undetermin'd by any laws, as we may chiefly learn from the *Persian*, *Median*, and *Armenian* names.

Whether the
Volga is the *A-*
rares?

The *Volga*, therefore, is that *Araxes* to the east of which the ancient *Scythians*, the neighbours of the *Massagetæ* and *Iffedones*, dwelt; for, not only *Herodotus*, but likewise all the ancients, place the *Massagetæ* to the north-east of the *Caspian* sea. *Laonicus Chalcocondylas*^x places them to the north of the *Caspian* sea; and he moreover adds, that before that time they dwelt on the other side of the *Araxes*; but that now passing that river they possess'd the hither part; and any one may plainly see, that this *Araxes* is the *Volga*; and as this river is of a very large extent, and possess'd by many nations, it is no wonder if it gave its name to some of them; as now the *Bulgarians* coming from the *Volga* retain the name they took from the river: And thus I suppose the *Russians* are call'd from the same river *Roxalani*, the *Alani*, as it were, on the river *Rus*; and the *Boruscii* of *Ptolemy* for the same reason.

Araxes where
Cyrus was defeat-
ed by the *Massa-*
getæ what?

I take this to be that *Araxes*, near which *Cyrus* was defeated by the *Massagetæ*. When *Herodotus* heard, that *Cyrus*, after passing the *Araxes*, had gone in quest of the *Massagetæ*, and that from *Babylon*, he thought it was the *Araxes* of *Media*; and such as understood him amiss, would find out another *Araxes* in the east, for *Cyrus* to cross and attack the *Massagetæ*, *Isaac Vossius* has chose *Oxus*, and in this he is follow'd by *Cellarius*; yet they have nothing that makes for that opinion, and the *Massagetæ* were farther from the *Oxus*; on which account some ancients, according to *Pliny*, placed the altars of *Cyrus* beyond the *Iaxartes*, as if it were the *Araxes*. But the *Scythians*, as *Pliny* says^y, or whatever other people inhabited on this river, call'd the *Iaxartes*, *Silyn*, or probably *Sibyn*, a name which

^u *Ib. lib. 1. c. 4.*
^y *Lib. 4. c. 16.*

^w *De emendat-temp. f. 399.*

^x *f. 62. and 67. Ed. Paris.*

which still remains: And yet there is no probability in favour of *Iaxartes*. *Cyrus* went into this expedition, as it seems to us, not against the *Massagetæ* alone, but principally against the *Scythians*; for, it still stuck in the minds of the kings of *Persia* how weakly the *Scythians*, after conquering the *Medes*, had acted in the *Upper Asia*: And that war, the origin of so many others, is related by *Herodotus*, who very carefully applied himself to shew by what causes wars arose from wars. *Cyrus* took *Babylon*, according to *Usher's* calculation, in the year 4176 of the *Julian* period; and a little more than a year after, if we credit *Xenophon*, he subdu'd the nations from *Syria* as far as the *Red* sea: And hence there are still behind seven years at least to the death of *Cyrus*; and in all this time he could have acted both in the *Lesser Asia*, at Mount *Caucasus* and in *Scythia*, till having open'd a way into these countries by his arms, and passing over the *Volga* in ships, and by a bridge he caus'd to make, he attack'd the *Massagetæ*.

A Chronological Enquiry into the periodical Revolution of the Comet An. 1668 and 1702. By Alphonfus des Vignoles. From the Miscellanea Berolinensia, Tom. I. p. 251.

Translated from the LATIN.

IN March^a 1668, at which time that excellent astronomer, *Joh. Dominicus Cassini*, was still at *Bononia*, he observ'd a certain light in the heavens, which he judg'd to be a comet, and from its bigness, figure, motion, and site among the stars, he suspected it to be the same phenomenon with that observ'd 2000 years ago, and of which *Aristotle*^b makes mention, and from him *Seneca*^c. Thirty-four years after, to wit, in 1702, *Maraldi*^d observ'd a like light at *Rome*, and in the same month of *March*, which immediately brought into his mind a conjecture of *Cassini's* 34 years before. Upon understanding this, *Cassini*^e undertook to confirm his conjecture by various arguments: And in the first place he asserted, that *Aristotle's* comet was seen in the year 373 before *Christ*; and that from a threefold chronological character. 1. From the year in which *Astæus*, call'd by *Aristotle* *Aristæus*, was *Archon* at *Athens*. 2. From the time of the earthquake in *Achaia*, when the towns *Helice* and *Bura* were destroy'd, of which *Aristotle* also makes mention. 3. From the battle at *Leuctra*, in which the *Lacedemonians* lost their sovereignty two years after the appearance of the comet. In the second place reckoning backwards from *Anno* 1668, 60 revolutions of 34 years each, which make 2040 years, he found the above year to be

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The comet in 1668 and 1702 suppos'd to be the same with that seen in *Aristotle's* days under the *Archon Astæus*.

^a *Journ. des Sçav. An. 1668, Journ. 5. n. 6.* ^b *Aristot. meteor. lib. 1. 6.* ^c *Quæst. natur. VII. 5.* ^d *Memoir. pour l'histoire des Sciences à Trevoux An. 1703, Juillet. Art. 2.* ^e *Mem. de l'Acad. des Sciences An. 1702. p. 106, 107, 108. Ed. de Paris.*

373 years before Christ: Whence he concludes, that a period of 34 years is to be assign'd to that comet.

This oppos'd by
Dutal.

This opinion was oppos'd by *Dutal*, physician at *Paris*, in the *Nouvelles de la Republique des Lettres*^f.

And in the first place he animadverts on *Maraldi* and *Cassini*, for saying that *Astæus* was *Archon* in the fourth year of C Olympiad, who was in that office in the fourth year of CI Olympiad, as appears from *Diodorus* and *Pausanias*, whose words he adduces; and that, therefore, they mistake a whole Olympiad.

Defended by the
author.

But in the first place we are to observe, that *Maraldi* made no mention of *Astæus* the *Archon*, nor of the interval of years, of which we shall treat in the second place. I own that the *Memoires de Trevoux* might in some measure have given occasion to this mistake, in which *Maraldi*'s observation is not accurately enough distinguish'd from *Cassini*'s: But the observations of both astronomers are to be seen distinct in the *Memoirs of the Royal Academy of Sciences at Paris*^g.

Besides, I find no real error in *Cassini*, but only a slip of the pen; for, seeing *Cassini* refers these things to the year 373 before Christ, he most certainly means the fourth year of the CI Olympiad^h; as may be seen in the following schemeⁱ; and which *Dutal* often owns. Again the other characters noted by *Cassini*, as the earthquake in *Achaia* and the battle of *Leuctra*, do most certainly show that *Cassini*, when he would define the time of the appearance of the comet, meant the aforesaid year, to wit, the fourth of CI Olympiad; it was, therefore, a mere slip of the pen, or an error of the transcriber, who writ C for CI.

I would have it also observ'd, that *Dutal*^k, as often as he mentions the above *Archon*, or when he speaks in his own person, or when he quotes others, he always calls him *Arstæus*, who has been unanimously call'd *Astæus*, (as *Cassini* calls him) not only by *Diodorus*^l and *Pausanias*^m, whom he himself quotes, but even by his cotemporary *Demosthenes*ⁿ in six different places, and in the *Arundellian* marble^o at *Oxford*, wherein the more celebrated *epocha*'s of the *Greeks* are exhibited; to whom may be added *Scaliger* in his *Collectiones historicæ* publish'd with *Eusebius*^p. *Aristotle*^q is the only one who call'd the *Archon*, *Aristæus*, and none of the ancients, as far as I know, call'd him *Arstæus*.

2. *Maraldi* is also free of another mistake, alledged to him. ' From the fourth year, says *Dutal*, of C Olympiad (which is to be read CI, as I have already hinted) down to *Maraldi*'s observation, there are 2078 years elaps'd; and not 2040 only'. But

^f *An.* 1716. *Decem.* *Art.* 1. *b* p. 606. *c* p. 611.

dès Scav. *An.* 1707. *Jan.* p. 217. Ed. Amst.

p. 603 614.

Ed. Kuhnii 1696.

Let. Basil 1572.

a *Meteor.* I. 6.

^l XV. p. 482 Ed. Grec. Steph.

^m In *Nearam* p. 522. & *Adv.* Timoth. p. 700 *seq.* Ed. Grec.

^o *Marm.* Oxon. *epoch.* 72.

^g p. 101. 102.

ⁱ *Neuvel. &c.* p. 607, 612.

^h *Journ.*

^k *Ibid.*

^m VII. p. 589. & IX. p. 713.

^p *Scal. Eusebian. Grec.* p. 326.

But these things can in no manner affect *Maraldi*, as I observ'd above. The words alledged are those of a certain letter of *Blondel*, which the authors of the *Journal de Trevoux* have inserted into their *Memoirs*^r. *Blondel* explicitly owns, that he writ it only so far as his memory could serve him; for, he speaks thus at the very beginning; 'I send you a relation, as faithful as my memory could supply me with, &c.'^s And towards the close, 'this, *Sir*, is as far as my memory could serve me.'^r

Again *Cassini* corrected this error, however, in the *Memoirs of the Royal Academy* for the year 1702, as *Dutal* himself owns, whose words are these, 'M. *Cassini* has corrected this anachronism, reckoning 2040 years between the observation of *Aristotle* and his own of 1668, and not of 1702, as *Maraldi* had done'^v.

3. It is objected to *Cassini*, that he should have said that *Diodorus* referr'd that *phenomenon* to the times of *Astæus*, since it appears that *Diodorus* referr'd it to the times of *Alcisthenes*, who succeeded *Astæus*^w. Upon considering *Cassini's* words, it will appear, that they bear another meaning, they are to the following purpose; 'Diodorus Siculus says, that this *phenomenon*, which appear'd in the days of *Astæus*, consisted in a great long light like a beam'^x; for, these words, which appear'd in the time of *Astæus*, may be understood, as respecting what went before, to wit, *Aristotle's* account, in whose time this *phenomenon* appear'd, not as if *Diodorus* had said this, but that the thing was so.

Yet there remains something in *Cassini's* words, at which I stick, and which I could wish were farther explain'd by him.

P. Jul.	A Ch.	Olymp.
434 ¹	373	
		<i>Astæus</i>
		CI 4
434 ²	372	Comet, Earthquake.
		<i>Alcisthenes</i>
		CII 1
4343	37 ¹	
		<i>Phraclides</i>
		2. Battle at Leuctra.

1. We all take it for an undoubted truth, that, according to *Aristotle's*, the comet appear'd in the year *Aristæus* was *Archon* at *Athens*, whom
VOL. I. N° 8. Y others

^r An. 1703. ^s *Fevrier*. art. 2. ^t *Juillet* art. 2. ^v *Nouvel*. &c. p. 608.
^w *Nouvel*. &c. p. 610. ^x *Ibid*. p. 609. & *Mem. de l'Acad.* p. 107. ^y *Meteor.* I. 6.

others call *Astæus*, that is, in the fourth year of the CI olympiad, which began in the year 373 before the birth of Christ, or as chronologers chuse to speak, in the year 4341 of the *Julian* period: To this I add the testimony of the *Arundellian* marble²; for, there we read the following words, with *Selden's* supplement thereto: 'While *Astæus* was *Archon* at *Athens*, 'there shone in the heavens a large comet^a'. *Pausanias*^b adds his suffrage, but more obscurely, who while he relates at full length the earthquake, in which *Helice*, a town of *Achaia*, was swallow'd up, among other things he says, 'that at that time there were seen fires with long 'tracts of flames running up and down in the heavens^c; as also that unusual 'forms of stars struck a great terror into mortals^d.' And he subjoins the words quoted by *Dutal*^e, namely 'that *Helice* was entirely destroy'd, 'when *Astæus* was *Archon* at *Athens*, in the fourth year of CI olympiad, 'in which *Damon* the *Thurian*, was for the first time declar'd conqueror 'at the *Olympic* games'. We have, therefore, three concurring witnesses who affirm, that the above comet appear'd in the magistracy of *Astæus*, which doubtless must be granted to *Cassini*, tho' *Dutal* opposes it.

Time of the year
this comet ap-
pear'd.

2. I shall only enquire into the season of the year, wherein that comet made its appearance. What has a regard to this is but slightly touch'd on by *Cassini* in the *Memoirs of the Royal Academy*, in which he only mentions this from *Aristotle*, to wit, 'that it was seen at last to appear at the 'south-west and in a time of frost, that this *phenomenon* daily retir'd 'towards the east, and ascended towards the belt of *Orion*, where it ceas'd 'to appear^f.' He had more fully express'd himself in the *Journal des Sçavans*^g twenty years before in the following words; 'this philosopher 'speaking of this phenomenon, says, that it appear'd to the south-west; 'he adds, 'that the great star, of which he spoke before, appear'd in the 'winter in frosty and very clear weather about the evening; that the first 'day it did not appear, being set before the sun; that the following day 'it appear'd a little, because it set a little later; and that it ascended to 'the belt of *Orion*, where it disappear'd.'

About the vernal
equinox.

I am much mistaken, if we must not conclude from all this, that the comet appear'd about the vernal equinox; for, 1. It is not yet winter at the autumnal equinox, nor is there (but very rarely) frosty weather, especially in *Greece*. Again 2. The comet was then near the sun, and not seen at first, because it set before the sun; but advancing a little according to the order of the signs, it was seen about evening, as it set after the sun. 3. And lastly, If it had happen'd about the autumnal equinox, the comet could not have come to the constellation of *Orion*. These

(13 J

² Marm. Oxon epoch. 72.
[ἐν τῷ ἔργῳ μέγας Κορήτης]
velles Ec. p. 607.
Ed. Amst.

^a Ἀρχοντοῦ Ἀθηνησιν Ἀσεῖς Κατεκρή δὲ τότε καὶ
^b VII. p. 585. ^c p. 586 ^d p. 589. ^e Nou-
^f An. 1702. p. 107. ^g An. 1683. Journ. II. p. 139.

These things, therefore, happen'd about the vernal equinox, as I have already said, which this far agrees with the comets of 1668 and 1702.

3. Having laid these things down, it seems, that the comet observ'd An. A. C. 372. by *Aristotle* is not referable to the year 373 before the birth of Christ, but to the year 372, or to the year 4342 of the *Julian* period. It is a thing well known to all the learned, that the years of the olympiad began about the summer solstice; and with these (at least at this time and afterwards) coincided the *Attic* years, at the beginning of which the *Archons* at *Athens* enter'd on their magistracy: Whence it necessarily follows, that *Astæus* was *Archon* from the summer of 373 to the summer of 372 before Christ: The vernal equinox, therefore, when *Astæus* was *Archon*, fell in the year 372; and consequently, the comet was seen in 372, and not in 373: And this I would hint in the first place. And doubtless, *Calvisius* took it so, who refers the comet to the year 370 before the birth of Christ, which he supposes to be the true *epocha*, that is, to the year 372 before the vulgar *Æra*: But as to what he adds from *Diodorus*, when *Alcisthenes* was *Archon*, will be explained anon.

4. *Diodorus Siculus* confirms our opinion, to whom *Dutal* objected, as differing from *Aristotle* by one year. 'When *Alcisthenes* was *Archon* at *Athens*, *Astæus*' successor, says *Diodorus*, was solemniz'd CII olympiad, in which *Damon*, the *Thurian*, was the second time conqueror at the Olympic games, then a large light was seen to shine for several nights in the heavens, &c.^h *Scaliger* has the very same words in his *Collectio historiarum*ⁱ. If these words are repugnant to *Aristotle*, as at first view they seem to be, it is surprising, that *Dutal* should prefer *Diodorus*, who writ 400 years after, to *Aristotle*, in whose time the comet had appear'd^k. *Aristotle*, says he, being then only eleven years of age, might be very easily mistaken. But what if we should add to the testimony of *Aristotle* the *Arundellian* marble? He would probably object the *hiatus* therein: And what if we should adduce *Pausanias*? He would object his obscurity. I allow that *Diodorus*' work is excellent and greatly to be valued; yet let us hear *Vossius*^l on this head, 'Diodorus' mistakes are so many in the years of the olympiads and the *Roman* magistrates, that it is probable, he made use of corrupted and defective *Fasti*: And on this account he is taken to task not only by *Bodinus*, but likewise by *Sigonius*, *Stephanus*, *Pigbius* and other chronologers.' Yet *Dutal* has preferr'd this historian to *Aristotle*, a natural philosopher, and treating on a natural phenomenon, and who far more accurately sets down the time of the comet's appearance.

It does not seem to us a difficult matter to reconcile *Diodorus* and *Scaliger* his transcriber with *Aristotle*, the *Arundellian* marble and *Pausanias*; *Diodorus* reconcil'd with *Aristotle*, &c.

Y 2

^h Diodor. XV. p. 483.
&c. p. 614.

ⁱ In Eusebianis Græcis p. 325. edit. 1658.
^l De Hist. Græcis I. 2.

^k Nouvelles

nias; for, I have often observ'd, that *Diodorus* anticipates by some months the years of the olympiads, which began about the summer-solstice, as also the magistracy of the *Archons*, who were created at the beginning of the year^m: And that they generally commence from the time in which the *Roman* consuls, whose names he usually prefixes to each year, enter'd on their magistracy. 1. Either *Diodorus*ⁿ, firman'd *Siculus* from his country, and living for a long time at *Rome*, would accommodate the years of his history to the way of reckoning among the *Romans*, who began their years from the calends of *January*; or 2. That the campaigns of each year might be uninterruptedly related, which appears to have been *Thucydides*' method before him; or 3. and lastly, because the beginning of the ancient *Attic* year was after the winter-solstice, as very lately *Dr. Potter*^o has affirm'd; and which *Joseph Scaliger*^p, the Prince of *Chronologers*, has shewn in several places. Whatever may have been the reason, having more than once had experience of the thing, I could show it by several instances, were I not persuaded, that it is a thing certainly known to the learned: But if any one would call it into question and would require arguments to prove it, let him only read the life of *Alexander, the Great*, in *Diodorus*' XVII. book, as being a part of ancient history that is very well known, and let him compare it with *Plutarch*, *Arrian* and *Quintus Curtius*, and he will observe that *Diodorus* generally, nay always anticipates the true years of the *Archons* by several months.

How *Diodorus*' years are to be reckon'd.

This being laid down; the first part of each year in *Diodorus* is to be referr'd to the end of the preceeding year of the olympiad: And from this we have an answer to *Dutal*'s objection, and our opinion is confirm'd; for, if the comet observ'd by *Aristotle* appear'd about the vernal equinox of the year 372 before Christ, as we have shown above, it really happen'd, while *Astæus* was still *Archon* at *Athens*; but according to the above method it should be referr'd by *Diodorus* to the times of *Alcisthenes*, tho' he was only created *Archon* some months after.

Cassini's second chronological character fixes it to 372.

5. As to the other chronological character (by which *Cassini* has confirm'd his opinion, to wit, the destruction of *Helice* and *Bura*) it seems to make more for determining the year 372, than to be against it.

For, 1. *Aristotle*^q, when he says, that the comet appear'd about the time of the earthquake in *Achaia* and the inundation, seems to hint, that there was a small interval of time between the comet and the destruction of these towns. And again 2. *Pausanias*^r asserts, that this inundation happen'd in winter. 3. *Strabo*^s before him said, that this calamity happen'd in the night time and in winter. All which, join'd with the vernal equinox, of which in N. 2, entirely favour our opinion, and cause us to refer this calamity

^m *Vid. Suidam in FIOTHPIA & Hesychium in EΞITHPIA.*
Græc. II. 26. col. 423. Ed. Amst. 1702.
Isag. p. 232. 238. 9. Meteor. I. 6.
Ed. Basil. 1549.

ⁿ *Præfat.*

• *Archæol.*

^p *Emend. temp. p. 34. 42. 55. & Can.*
^r VII. p. 587. ^s VIII. p. 370, 371

to the year 372; to which year also not only *Salianus* quoted by *Dutal**, but likewise *Bucholcerus* and *Buntingus*, no mean chronologers, have likewise referr'd it.

6. It remains, that I say something of the battle of *Leuctra*, which *Cassini* has also employ'd here; for, in enumerating the chronological characters of the above comet, after the magistracy of *Astæus* and the subversion of *Helice*, he lays down in the third place the battle of *Leuctra*, 'by which the *Lacedemonian* commonwealth was overturn'd, and it happen'd two years after the appearance of this phenomenon'. I could have wish'd, that *Cassini* had by some testimonies, or arguments, prov'd that interval of two years. *Diodorus*^t has only said, 'that in a little time after the comet the *Lacedemonians* were defeated in a great battle, and all of a sudden, which no one would have thought, lost their sovereignty'; which is almost the very same thing with what *Polybius*^u says, 'that the town of *Helice* was swallow'd up by the sea a little before the battle of *Leuctra*;' tho' the word *paulo* (a little) is added by the translator: Nor do I believe that *Cassini* had thought of the *Arundellian* marble^w, whose date will be consistent, providing 13 months intervene between the time of the comet's appearance and the battle of *Leuctra*, as shall appear anon. He had, probably, a regard to a passage in *Strabo*^x, wherein he says, 'that *Helice* was swallow'd up two years before the battle of *Leuctra*.' But neither are these two years to be taken strictly, as if two whole years were elaps'd: For, since the battle of *Leuctra* happen'd about the summer-solstice, as we shall see anon, it would hence follow, that the comet also appear'd about the summer-solstice, which, from what was said above, appears not only to be impossible, but likewise repugnant to *Aristotle's* design, who adduces the instance of this comet in order to prove the falshood of what some affirm'd, to wit, that comets only happen when the sun is about the summer-solstice^y.

7. If the calculation is rightly made, we shall, indeed, find a year and a quarter interven'd between the time of the appearance of the comet and the battle of *Leuctra*. *Dionysius* of *Halicarnassus*^z relates, that at *Lacedæmon* peace was struck up between the *Greeks*, except the *Thebans*, at the time that *Alcisthenes* was *Archon* at *Athens*, which falls in with the first year of CII. olympiad. To this also agrees *Diodorus*^a, as also his transcriber *Scaliger*^b, who have the same *Alcisthenes* and the same year; but *Plutarch*^c in *Agésilæus* more accurately says, that the peace was made on the 14th of the month *Sciophorion*, that is only 16 days before the close of the year of the olympiad. The same *Plutarch*^d adds, that the battle of *Leuctra* happen'd 20 days after the peace, to wit, on the 5th of the month

Cassini's third chronological character.

About a year and a quarter interven'd between the comet's appearance and the battle of *Leuctra*.

* *Nouvelles*, &c. p. 611. ^t *Mem. de l'Acad.* p. 107, 108. ^u *Μικρὸν δ' ὀστρεὸν* XV. p. 483. ^w *Marm. Oxon. epoch.* 72, 73. ^x VIII. p. 370. ^y *Arist. l. c.* ^z *Lyfia T. II.* p. 85. Ed. *Lypf.* 1701. ^a XV. p. 483. ^b *Eusebian. Græc.* p. 325. a. ^c *T. I* p. 611. f. Ed. *Francfort* 1620. ^d p. 612. init.

month *Hecatombæon*; and again in *Camillus*^c he assigns the 5th of *Hecatombæon* for the battle of *Leuætra*, which was the first month of the year of the olympiad, in which a new *Archon* was created at *Athens*. Hence it is, that the *Arundellian* marble^f asserts, that the battle of *Leuætra* happen'd under the *Archon Phrasiclides*, who succeeded *Alcisthenes*, that is, the second year of the same olympiad CII. And from this differ not *Diodorus* and his transcriber *Scaliger*, to whom may be added *Pausanias*^g, whose words are these; 'the *Lacedemonians* were defeated at *Leuætra*, when *Phrasiclides* was *Archon* at *Athens*, in the second year of CII. olympiad, in which *Damon*, the *Thurian*, was the second time conqueror at the *Olympic* games.' From all which it appears, that between the appearance of the comet and the battle of *Leuætra* there interven'd one year and a quarter, namely, the space of time from the vernal equinox of the year 372 to the summer-solstice of the year 371 before *Christ*: But this by the bye, since from the battle of *Leuætra* nothing certain can be deduced for determining the exact time of the comet's appearance.

8. To conclude; from what has been said above, a difficulty arises about the period of 34 years, which *Cassini* has assign'd to this comet; for, if to the year 372 before *Christ* less by one quarter we add the years elaps'd, viz. 1667, together with one quarter from the beginning of the *Christian* æra down to the comet observ'd by *Cassini* at *Bononia*, we shall have only a total of 2039, and not 2040. Whence it appears, that the 60 revolutions, each of 34 years, are not complete, but that the total is one year short: We must, therefore, suppose a shorter revolution, which *Cassini*^h has not thought improper; or the hypothesis is to be salv'd by some anomaly or other; or the matter is to be set to rights in some other manner. We are greatly indebted to *Cassini*, that in 1668 he hinted what the year 1702 has seem'd to verify; but, after some more revolutions, posterity will with the greater certainty judge of the whole matter.

Vegetable Gold; by Phil. Jac. Sachs à Lewenheimb. *From the* *Miscellanea Naturæ Curiosorum*. An. I. Dec. I. Obf. CXXXI. p. 290.

Translated from the LATIN.

Several instances
of vegetable gold.

IN his Imperial Majesty's repository, among other curiosities of nature and art, is kept a sort of vegetable gold, which sprung out of the earth like a twisted thread: This pure gold, call'd *aurum obryzum*, was found by a boor in the river *Tartza* near the village of *Tartza*, four miles wide of the city of *Epperies* in *Upper Hungary*; and this thread was found to weigh half an ounce and two drachms, and to be almost an ell long.

^c p. 138. init.

^f *Epoch*. 73.

^g VIII. p. 656.

^h *Mém. de l'Acad.* p. 105.

long. It is, indeed, a surprising thing, that metals, laying aside their metallic nature, should sometimes spring out of the earth in the manner of vegetables, and grow up in the form of a plant. *Fortunius Licetus*^a relates from *Aristotle de admirandis*, that gold, buried or thrown into the earth, has sometimes grown up; and from *Fulgosius*, that near *Firmium*, a town of *Pannonia*, sometimes in the vines were found real gold-tendrils; and that pieces of gold have been coin'd of them.

To this may be added the several following instances. *Petr. Martyr*^b Particularly in the vine. relates, that in the island of *Hispaniola* in *America*, which abounds very much in gold, there are trees in some mountains with living veins of gold; and that wherever it has a passage it sends forth from the root thro' the open and soft springs branches to the uppermost brow of the hill, which never cease growing, till they get into the open air; and they have observ'd, that then it forms buds of gold. In *France* in the year 1602, upon finding very rich ores of gold in a vineyard near the village of *St. Martin la plaine*, in the territory of *Lyons*, one of the pieces of this virgin-gold so artificially represented a golden palm-tree with its buds, that it was presented to *Henry le Grand* to his great surprise, as this is related by *Petr. Matthæus*^c. That some vines on the *Maine* and *Neckar* have some twigs and often whitish leaves germinating from pure gold and coalescing together, is related by *Alexander ab Alexandro*^d, *Gaudentius Merula*^e, *Anton. Mizald*^f, and *J. Bapt. Porta*^g. The like also happen'd a few years ago in the vineyards of *Germany* about *Dresden* on the *Elbe*, where a vine-dresser observing a string shooting out from the soil of a certain fruitful vineyard, he drew it out gently to the length of some ells, till it broke: What he had drawn out appear'd by the touch-stone to be pure gold. In *Hungary*, a country much abounding in minerals, in 1651 *Matthæus Held* saw in the fortress of *Batak*, near *Tokay*, the grape-stones shining with hard particles of gold; and this account I had afterwards from his own mouth. *Job. Joachim Becher*^h saw in *Hungary* a vine growing above a vein of gold, whose trunk was not only all over cover'd with threads of gold, as it were, but in some of the grape-stones were found grains of pure gold. *Dr. Martin. Henric. de Franckenstein*, a physician of *Epperies*, inform'd me, that he was possess'd not only of some grape-stones found about *Tokay*, that were impregnated with grains of gold; but he also communicated to me the following account, that in *Hungary* a certain nobleman, call'd *Walpotaky*, had a vine-dresser who observ'd a kind of yellow matter springing out of the earth, and attempting to pull it up, he observ'd it strike root deep into the earth and adhere to it very closely; and at length, with a great ado, he pull'd out an ingot of gold, which he shew'd to a goldsmith, who told him it

was:

^a De spontan. vivent. Ostu. lib. 4. cap. 72. ^b In Reb. Oceanicis Decad. 3. l. 8. p. m. 296. ^c Hist. Gall. Tom. II. l. 5. narr. 1. p. m. 209. ^d Lib. 4. gen. dier. cap. 9.

^e Cosmograph. lib. 10. cap. 27. ^f Cent. 2. memorab. § 1. ^g Phytogn. lib. 2. cap. 6.

^h Metallurg. part. 1. c. 1. p. 2.

was very fine. In some time after he observ'd another ingot springing, which he pull'd up ; and this he repeated so often, till there ensu'd a law-plea between him and the nobleman ; and at length with the prince himself, about the right of possession to this vineyard. And *Frankenstein* testifies, that this dispute was a thing well known in those parts. And moreover, that a few years ago a Boor being at plough near *Epperies* pull'd out of the earth some ells of gold thread.

As also in other
vegetables.

Besides the vine, other trees according to *Job. Chrysoft. Magnenus*ⁱ produce metals near the gold mines in *Monomotapa*. In *Silesia*, near the confines of *Moravia*, a few years ago about *Oppavia* a thread of gold was found with its proper root springing out of the earth, and of no inconsiderable weight ; and several such threads were afterwards found there : And one of these threads was in the possession of the baron *de Reisewiz*, which he also shew'd me.

Instances of ve-
getable silver.

What has been said of gold is also mention'd by others of silver. *Oswald Grenbs*^k relates, that in mines silver has often a capillary appearance. In the *Museum* of *Ferdinando Imperati* at *Naples* is shewn a natural shrub of silver, which was dug up in a silver-mine.

This vegetation
accounted for.

The cause of this vegetation in metals is variously explain'd by authors : Some are of opinion that, those metallic tendrils grow in the same manner as the horns of deers do ; that if gold adheres to trees like bind-weed, it is owing to its toughness and softness out of its native soil, and that it may also happen from its native softness on account of the narrowness of the place, whereby, as it is forced out of the earth, it is twisted round : And in fine, that vines and trees attract by their roots the metallic humour, in which there was some particle of gold before generated ; for, that the matter of the generation of metals is a fluid, and therefore easily yielding : And of this opinion is *Kircher*^l, if plants have a natural propensity to places where metals grow, that they assume the nature of that metal over which they grow, since the nourishment expiring from the metallic vapour is attracted by them. In fine, *Jo. Faber Lincaus*^m having told us, that there are *zoophyta*, i. e. an intermediate species between animals and plants, he also relates, that the illustrious prince *Cæsius* first discover'd and observ'd an intermediate species between plants and minerals, who was to treat express on them in his books *de Metallophytis*.

ⁱ Democrit. Rediv. p. 295.

^k Arbor. homin. l. 1. c. 7. f. 5. § 18.

^l De Magnete

l. 3. p. 5. c. 3. p. 631.

^m In Not. ad Hist. Mexican. f. 573.

A mathematico-physical essay towards finding the height of the Atmosphere. By S. K. From the Acta Literaria Sueciæ Trimestre I. An. 1723. p. 385.

Translated from the LATIN.

Theorem.

IF the density of the air be proportional to the force compressing it, and the heights be taken in an arithmetical progression, the densities will be in a geometrical progression.

Let

Let the heights AB, AC, AD, AE, &c. be taken in arithmetical progression, by which very thing the distances BC, CD, DE, &c. become equal; let the perpendiculars Bb, Cc, Dd, Ee, &c. be rais'd, which may be understood to be respectively proportional to the densities in B, C, D, E, &c. And let the perpendiculars cβ, dγ, eδ, &c. be let fall; then suppose the density in F to be continu'd invariable to E, that in E to D, that in D to C, &c. whence the quantity, and consequently the weight of air, contain'd between F and E, E and D, D and C, &c. will be expounded by the spaces FEεf, EDδe, DCγd, &c. or by the right lines Ff, Ee, Dd, &c. respectively proportional to these spaces: Besides, let the weight or quantity of air, incumbent on the point F, be expounded by the given quantity P.

Demonstration.
Fig. 1. Pl. IV.

Now because the density of the air is proportional to the compressing force (by the hypothesis) and consequently to the weight of the incumbent air, Ff, Ee, Dd, Cc, &c. will be proportional to P, P + Ff, P + Ff + Ee, P + Ff + Ee + Dd, &c. respectively, and the differences of the former εe, δd, γc, &c. will be proportional to the differences of the latter Ff, Ee, Dd, respectively: Wherefore, since the right lines Ff, Ee, Dd, &c. are proportional to their differences εe, δd, γc, &c. they will be in continual proportion.

Lastly, let it be suppos'd, that the number of right lines Bb, Cc, Dd, Ee, &c. is augmented, and that at the same time the distances BC, CD, DE, &c. are diminish'd *in infinitum*; yet still those right lines Bb, Cc, Dd, Ee, &c. now cull'd out by equal skipping, will likewise be proportional: And by that means the densities will, by the hypothesis, be proportional to these right lines. Q. E. D.

Hence it appears, that the height is proportional to the logarithm of the density; and consequently, if in two given heights the densities be known, the altitude corresponding to any other density may be found; namely, if any one of the given densities being assum'd for unity, the logarithm of the other be sought, and you infer, as this logarithm to the difference of the given heights, so is the logarithm of any third density to the difference of the heights between this third density and that assum'd for unity.

Corollary.

According to these principles, and an experiment made in *September 24, 1722*, with a barometer in the turret of the cathedral church at *Upsal*, it is found by a calculus, that the altitude of the point, to which the density corresponds, (which is to the density near the earth as 1 to 14,000) is 7 miles and 14567 *Swedish* ells: And if this density be the least, which the air can have, the height found will be nearly that of the atmosphere itself.

Scholium.

Of the Hungarian Wines. From the Breslaw Collection, October, An. 1717, Class III. p. 190.

Translated from the HIGH-DUTCH.

What influence the weather has on the wines of different countries.

THE vine is the principal and peculiar glory of the month of *October*, as by its warmth the most diluted and tart *German* wines are sufficiently concocted. In *Austria*, and particularly in different parts of *Hungary*, on the contrary, the wine is not sufficiently good, mellow, and palatable, unless, amongst other things, some frost happen either before or in the time of vintage, which in these parts is observ'd to impart a remarkable mellowness to the wine, especially if a warm summer and moist harvest happen to preceed.

Raisin-wine what? Two species thereof, and how prepar'd.

Such grapes as begin to dry upon the vine are press'd and yield a generous wine, commonly call'd raisin-wine, yet improperly, as the true raisin-wine is prepar'd in the following manner. In good wine-years, when the clusters ripen well, such grapes or even clusters are pick'd out, as are entirely shrivell'd up and appear like raisins; and from these raisin-wine is made in a twofold manner; 1. After pouring press-wine on these grapes, and then expressing the juice, a more pungent and a more generous wine is had from them. 2. If these dry grapes, or raisins be press'd by themselves, without pouring to them the above must, they then yield the quintessence of wine, as it is call'd, which is like an oil, yet in a far less quantity. At *Oedenburg* in *Lower Hungary* no raisin-wine is usually made, but the grapes and clusters are left together: Hence it is that the *Oedenburg* wine is reckon'd the best in *Lower Hungary*. In *St. Georgen-stadt*, on the contrary, a great deal of raisin-wine is made; and always a sufficient quantity of it even in bad wine-years; and then they often make use of large raisins and even sugar. When the grapes are pick'd from the vine, they are shot into a butt or vessel, and stamp'd with the feet, the juice or must whereof is taken up, which afterwards yields what they call their stamp'd wine: Afterwards these stamp'd grapes are put into the press and their remaining juice squeez'd out, and this is call'd press-wine: If it is a good wine-year, the press-wine is better than the stamp'd wine; but if the grapes are not arriv'd to their true perfection, the latter is preferable to the former: Yet all this must necessarily be understood according to the situation of the ground, namely, as one hill stands better to the sun than another.

Of the different sorts of Hungarian wines.

We suppose it will not be disagreeable to the reader to give some account from the relations communicated to us, as to the produce of wine in *Hungary*: And 1. As to the difference of the wines in *Upper* and *Lower Hungary*. As to the *Upper Hungary* it is well known, that their wine is commonly divided into *Upper Hungarian* in general, and into *Tockay* in particular;

ticular; but taken together they are sweeter, as also for the most part more spirituous than the *Lower Hungarian* wines; yet of the *Upper Hungarian* wines some are better than others. The best are about *Santo* overagainst *Caschau*, yet compar'd with the following they are but small. Those about *Talia* are better, and those of *Mada* still better; but the best of all are about *Tockay* itself, as also those of *Kereftur* and *Tozwa*; all which commonly pass for *Tockay* wine, since these places lie within a few miles of *Tockay*. The *Lisker* wines (which place is about five miles from *Tockay*) are not so good as those of the five abovemention'd places; and least of all those of *Micotzer*; but this last may at first sometimes deceive a pretty good judge of wine, as they are very pleasant and taste pretty pungent at first, but in a little time they pall and turn; the reason of which is, that the vine-hill is not so high, nor does it lie so directly to the sun; for, this is the principal reason of the goodness of the *Upper Hungarian* wines beyond those of *Lower Hungary*, to wit, that the hills of the former are very high and lie directly against the sun's rays, which beat upon them in the strongest manner in a direct line; and which by their reflexion impinge upon, and consequently ripen the grapes well: Whereas, on the contrary, the hills in *Lower Hungary* are much lower and flat, and do not always lie so directly to the sun: Whence he shines upon them only superficially, and does not with sufficient force reach the root; and consequently cannot have so strong an effect upon the vine; as even the vine in the valleys near the best hills of *Upper Hungary* does not yield so good a produce as in the higher part of the hill: Besides, low hills have more moisture than the high, which, thereby are more apt to dilute the spirituous parts. Of the *Tockay* wines we are to observe, that it is a common mistake to pretend to find their specific quality and goodness in their being muddy, since this is always a sign, that the wine has not been well wrought and laid off; and such a muddy wine is either new, or if it be old and also muddy, it is owing to the negligence of the vintner. This muddiness may, among other things, be remedied and its clarifying promoted thus; namely, taking a part of a cask of old tunn'd wine, and drawing the new muddy wine thereon; and in 8 or 10 days it fines down, which before would not happen in 6 weeks or more. The method of managing wine in *Upper Hungary* is commonly not so good as in *Lower Hungary*, in regard that in *Upper Hungary* in filling the butts they throw into them a deal of the stalks and husks and whole grapes, which are left therein: And hence their wine is sooner wont to turn; whereas in *Lower Hungary*, on the contrary, their method is much neater. *Upper Hungary* alone delivers yearly a great quantity of wine, reckon'd in general at 10,000 butts; and each butt reckon'd from two and a half to three rundlets of wine.

Of the goodness of the *Hungarian* vintage each year, the intelligent can judge from our *Breslaw* grapes by the following experiment; they take a

A way of judging of the goodness of the *Hungarian* vintage.

grape between their lips and suck the juice out of the stalk-hole, but lay hold of the husk with their fingers; if the juice come entirely out of the husk, and if the husk is quite empty and thin, they judge that they have an infallibly good vintage in *Hungary*: On the contrary, if there is much pulp in the husk and the husk remains thick, the vintage is thought to be not so good.

Of the nature and preparation of Sperma Ceti. By Joachim Georg. Elsnerus. *From the Miscellanea Naturæ Curiosorum.* An. I. Dec. I. Obs. CXXXVI. p. 302.

Translated from the LATIN.

What *sperma ceti* truly is.

HE, who first gave the name *sperma ceti*, has impos'd on many; for, this was the reason that they thought, that it really was the *sperma* of the whale. Others, observing that its substance had no affinity with *sperma*, were of opinion with *Schröder*, that it was nothing but a fatty substance, that ow'd its rise to sulphureous exhalations from the earth, and was coagulated by the salt water and the agitation of the waves. *Gesner*^a is, indeed, of opinion that it is a marine substance, but not a *sperma*, yet something like it, or rather the fat of some sea-animals, as those of the whale-kind, who are of a huge bulk, and contain a deal of fat; that these fall upon each other, and mutually kill each other: Whence the above author thinks it probable, that a great deal of fat floats on the surface of the sea; an opinion which we think is not entirely groundless, nor do we reject all natural *sperma ceti*, tho' at present we shew, that our modern *sperma ceti* in the shops is merely factitious and compounded.

Factitious *sperma ceti* twofold.

Factitious *sperma ceti* is twofold; one sort prepar'd from the brains of the whale; another from his fat, a thing I learn'd in *Holland*. The following account was communicated to me by *Verny*, sworn druggist at *Montpelier*, which he had from a friend of his from the island of *St. John de Luca*, and is to this purpose; 'Upon diligent enquiry whence *sperma ceti* was taken and prepar'd, I understood it was from the brains of the male whale, as the female has none of it, but instead of it a kind of liquid fat, of which oil is made for lamps: But no such oil can be had from the substance of the brains of the male, but from it is made the above *sperma ceti*; but I could not learn the manner of preparing it.'

The secret of preparing it.

This assertion is very much confirm'd by *Jac. Paul Contant*^b, wherein he has not only explain'd the nature of *sperma ceti*, but communicated the secret of preparing it, as follows; 'I learn'd from the inhabitants of the place,

^a *Corollar. ad Tract. Valer. Cord. de sperm. cet. p. 30. l. 1. c. 51. p. 63.*

^b *Comment. supra Dioscoridem.*

place, that they have often seen an animal from which is taken what is
falsely call'd *sperma ceti*, that it is no other than the male of the whale-
kind, which in *Bayonna*, *Bayaris*, and in the island of *St. John de Luca*,
and in the places where it is taken, is call'd *Cachalut*. This animal is
25 foot long, and 12 foot high; its jaws are nearly 10 foot, and arm'd
with heavy teeth, which weigh a pound more or less, of which they
make hafts for knives. As to the part, from which the *sperma* (but
improperly so call'd) is prepar'd, it is the head, and in reality it is
nothing other than the brains of that fish; for, in melting it, I myself
have often found thin membranes, with which the brain is otherwise
naturally envelopp'd, which are roll'd up with that fat that the mass might
remain the more compact. The process, by which the brain is purified,
that it may appear white and scaly, is this; after the brain is melted, it
is pour'd into a pot, in which at other times they refine sugar; then
stopping up the lower hole it is left till it harden, but it must be left in
a moderately warm place, then the pot is to be tapp'd: Thus it is
purified, and in the space of a few days the whole mass will be found
white and scaly: And this is what I saw and learn'd about this prepa-
ration. But that which the northern people call *sperma ceti* is a kind of
fat, which they gather in certain places from dead and stranded whales,
which fat, after being purified and prepar'd with verjuice, is squeez'd in
a press; whence it becomes white, scaly and light, with a sea-smell;
and this matter is afterwards call'd *alosanthos*. And that last assertion
Gesner also proves in the place above-mention'd: 'There are, says he,
who put into a cold cellar the fat of any whale receiv'd in a vessel,
then press it, that the thinner parts may run out, which is like an oil,
and has the same virtues with the grosser part which remains behind,
tho' thinner;' and this last is sold for *sperma ceti*, whose virtues, it is
true, it exhibits, but not so strongly.

1. We are to observe, that *sperma ceti* is not only prepar'd from the
brains of the whale, but that the brains of all large fishes are fit for this
purpose. 2. That the oil, press'd out in the preparation, is of greater
virtue than the *sperma ceti*: And among other things it is an excellent
anodyne.

We have the two following accounts from the *Philosophical Transactions*
of the *Royal Society* at *London*; one by *Richard Norwood* from *Bermudas*:
'I do not hear that they found any *sperma ceti* in any one of these
whales; but I have been credibly inform'd, that there is a kind of them
at *Elutheria* and others of the *Bahama* islands (where there is often found
a deal of ambergris) which have the *sperma*; and that those have large
teeth (which ours have not) and are very finewy. One *John Perinchief*
of this island of *Bermudas*, found one dead and driven on the shore; and
he

‘ he got a great quantity of *sperma ceti* out of it. It seems they have not
 ‘ so much oil as ours, but the oil, as I hear, is at first like *sperma ceti*,
 ‘ but they clarify it by fire.’

The other is from Mr. *Richard Stafford* from *Bermudas*: ‘ We have in
 ‘ these seas about *Bermudas* great store of whales, which use our coast in
 ‘ *March, April* and *May*: These we kill for their oil. But there have
 ‘ been *sperma ceti* whales driven on the shore; which *sperma* (as they call
 ‘ it) lies all over the bodies of those whales. At the *Bahama* islands I
 ‘ have found some of the same sort of whales dead on the shore, with
 ‘ *sperma* all over their bodies; they are strong and inlaid with sinews all
 ‘ over their body, which may be drawn out 30 fathom long.’

*A new Method of determining expeditiously the Tangents of Curve
 Lines. By D. T. From the Acta Eruditorum Lips. An. 1682.
 p. 391.*

Translated from the LATIN.

The use of the
 method of tan-
 gents.

HOW great the use of tangents is, is plain to such, as are appris'd,
 that while the tangents of curves are determin'd, by that very
 thing the quadratures of curvilinear spaces may also be exhibited:
 Wherefore, general methods of determining the tangents have been
 invented by the most excellent mathematicians. But as for the most part
 they require a very prolix calculus, such promote geometry in the best
 manner, who supply us with some easy method in a thing of so great use;
 and this *Slusius* in particular has done by a general and very simple rule.

A general rule
 for determining
 them.

Whence having hit on a rule, which determines the tangents much
 more generally and with greater simplicity than any hitherto given, I
 thought I should not begrudge to communicate it to the skillful in these
 matters.

For geometrical
 curves.
 Fig. 2. Plate IV.

Let BDE be any geometrical curve, as *Des Cartes* calls them, let the
abscissa BC be $=x$, the ordinate CD $=y$; and let the line determining the
 tangent AB be $=t$, let moreover the nature of this curve be given, which
 for instance, let be such that $y^3 + x^3 + xxy = xyy - a^3 + aay - aax + axx - ayy$: These things thus suppos'd, let the terms of this equation be
 order'd in such manner, that the greatest power of the ordinate CD or y
 be on one side of the equation: Hence now y^3 will be $= -x^3 - xxy + xyy$
 $-a^3 + aay - aax + axx - ayy$; but if the greatest power of the quantity
 y be entirely wanting, let all the terms be put $=0$.

Let there be made a fraction and its numerator in this manner; namely
 let all the terms, wherein the known quantity is, be taken with all their
 signs, and if the known quantity be of one dimension, let unity be pre-
 fixed to that term, if of two dimensions, 2, if of three, &c. 3, And in
 the

the present example the numerator will be $-3a^3 + 2aay - 2aax + axx - ayy$.

Let the denominator be made in this manner, assuming the terms wherein the *abscissa* x occurs and retaining the signs, if the quantity x be of one dimension, prefix unity as above, but if of two dimensions, 2, and it will be $-3xx - 2xy + yy - aa + 2ax$. But diminishing each of these by x , the denominator will be $-3xx - 2xy + yy - aa + 2ax$.

I say that this fraction is equal to the quantity AB; and therefore in the present case t is $= \frac{-3a^3 + 2aay - 2aax + axx - ayy}{-3xx - 2xy + yy - aa + 2ax}$. And thus in an easy and general way the tangents of all geometrical curves are exhibited.

But I shall further show, that the tangents of infinite mechanical curves may be determin'd by the same method; for, let there be any curve BDE, and let any portion thereof BD be put $=x$; but let DF be y ; and let any curve BF be form'd, for instance, according to the former equation $y^3 + x^3 + xxy = xyy - a^3 + aay - aax + axx - ayy$. To determine, therefore, the tangent AF of the curve BFG, I proceed thus, let a fraction be assum'd as was done above, and to it add the quantity x , and this will be equal to AD, a portion of the tangent of the curve BDE: And therefore,

For mechanical curves.
Fig. 3. Plate I.

In the present case if AD be drawn touching the curve BDE in D, and it be assum'd equal to $\frac{-3a^3 + 2aay - 2aax + axx - ayy}{-3xx - 2xy + yy - aa + 2ax} + x$, the right line AF being drawn, will touch the curve BFG in the point F. By the same method the tangents of the cycloid and of infinite mechanical curves are very expeditiously determin'd, and in so general a way, that where hitherto, by any analytical method, the tangent of one curve only is exhibited, here always at one and the same time the tangents of infinite curves may be determin'd; for, instead of the curve BDE we may suppose infinite curves that the tangent t may be always determin'd by $AD = \frac{-3a^3 + 2aay - 2aax + axx - ayy}{-3xx - 2xy + yy - aa + 2ax} + x$, supposing the nature of the curve BFG to be such, that $y^3 + x^3 + xxy = xyy - a^3 + aay - aax + axx - ayy$, and the curve BD $=x$, the right line DF $=y$.

I shall give the demonstration of all these things in their proper place, which yet any one but little conversant in analytics may easily draw from the methods hitherto exhibited by *Des Cartes*, *Fermat*, *Slusius*, &c.

Of a Milk Diet as a specific in the Gout. By Phil. Jac. Sachs à Lewenheimb. *From the Miscellanea Naturæ Curiosorum.* An. I. Dec. I. Obs. CXLI. p. 310.

Translated from the LATIN.

A new method
of curing the
gout.

THIS method of cure by a milk-diet has in a few years been receiv'd with great applause by great personages. I may call it a new remedy, which, after having lain long dormant, appears at length as in a new dress. The author of it is by some in our days suppos'd to be a Religious, who liv'd at the Count *de Megen's*, Governor of *Namur*; yet that it is a very ancient method of cure appears from *Pliny*^a, 'there are instances, *says he*, of those who have been freed from the gout by 'drinking asses milk.' Nay, according to the same *Pliny*^b, cows milk was reckon'd a *panacea*; 'for, *says he*, the *Arcadians* do not use physic, 'but milk about spring time, because then the herbs are very juicy and 'medicinal; and they drink cows milk, because they feed almost on all sorts 'of herbs.' And *Cornelius Celsus*^c says, 'that some people living on asses 'milk ever after escape the gout.' It is, therefore, within these few years, that the method of cure by milk has been restor'd, at the same time observing a very strict diet, and that nothing but pure milk be taken; and it is to be own'd, that by it arthritic pains, arising from acid and saline corrosive humours, as these are temper'd and successively soften'd by the sweetness of the milk; and if the diet be otherwise simple, without those various mixtures of meats and drinks, and if the constitution be suitable, may receive a great relief from this cure; and such a diet may be sufficient, since, according to *Varro*^d, milk is the most nourishing of all things we take: Whence *Athenæus*^e relates, that one *Philinus* all his life long used no other food or drink.

By a milk-diet.

The following account of the cure of the gout by a milk-diet was communicated to me by *Frederick Kopff*, Baron of *Neiding*, &c. This illustrious person had bound himself so strictly to this milk-diet, that as before the use of it he could neither move hand or foot, so afterwards he could walk without a stick, mount a horse, &c.

As follows.

His method was as follows, 1. Let the milk you take be from a red or black cow, and neither with calf or old; it is best, if it can be had, from a cow from which the calf has been taken up, and which has not been bull'd again. 2. Every one is to drink more or less of it, according to the constitution of his stomach: If the stomach be weak, it is to be drank four or five times a day; if five times, you are to order it so, as to intermit three hours; if four times you are to repeat drinking the milk every

^a *Lib.* 28. *c.* 9.
c. 9.

^b *Lib.* 25. *c.* 8.
^c *Lib.* 11.

^c *Lib.* 4. *c.* 24.

^d *De Re rust. lib.* 28.
four

four hours. I myself only drink it three times, to wit, about 6 in the morning, about 12, and about 7 in the evening, at each time four pounds and a half at least; but in other respects 16 or 18 pounds are to be drank a day.

3. Before this method of cure be enter'd upon, the body is to be purged two or three times, and that in the space of 10 or 14 days, and the purging to be manag'd according to the complexion of the patient.

4. After this you are to begin with drinking the milk; and it is properer to do so warm, as it comes from the cow.

5. To prevent the curdling of the milk, you may, if you will, put as much sugar to it as you please.

6. If you are bound in the belly, take of a morning 20 grains of the powder of *rhubarb* in the first draught of milk, drinking the rest of the milk upon it, or about evening take eight or ten grains of the essence of *rhubarb* along with the milk; and this to be so often repeated as there is occasion.

7. Some people, especially in the first 10 or 12 weeks, take each month between whiles a gentle purge, if it shall seem necessary; but if the belly be open, and the milk does not stay in the stomach, the *rhubarb* may be sufficient.

8. If the milk happen to cause a *diarrhœa*, before you drink of it, let it boil a little, adding a little salt thereto; and thus drink it warm; if this does not succeed the first time, let it be repeated twice or thrice.

9. If any degree of heat be caus'd by the use of the milk, let the third part of a ptisan of barley and currans be pour'd to the milk.

10. If you are dry between the whiles of drinking the milk, drink ptisan of barley and currans, or in defect of that, a draught of cold spring water.

11. During this drinking of the milk, no other food is to be taken, especially at first.

12. After this about noon take if you please an ounce or two of the crum of fine manchet, to be dipp'd in the milk, and eat them up together: If now for some weeks you have drank the milk, you may then twice a week take a poach'd egg, with some fine manchet, but without salt; you must entirely abstain from leaven'd bread, for fear of curdling the milk on the stomach.

13. After using the milk for 14 weeks, you may with more safety take of the following foods, yet so as not to overcharge your stomach, nor lessen the quantity of the milk.

14. For other food you may, therefore, take rice boil'd in milk, poach'd eggs or eggs fried with fresh butter, and fresh butter with fine manchet, hasty-puddings of milk and other milk dishes, yet so as to use no salt in any of them.

15. In summer the cows that supply the milk are to be fed on the best pastures, and on dry and not on marshy grounds; in winter they are to be fed with hay, wheat-straw, and wheat-bran.

16. The space of time for taking the milk cannot be exactly determin'd; the longer it is drank, the more perfect is the cure; some very gouty patients, to prevent a return, have drank it constantly for a year, and others for a year and a half: Some, having us'd a milk diet for half a year, upon their return to their old diet, and upon their exceeding therein by mixtures

of different foods, have again been seiz'd with the gout; but taking again to a milk-diet, the gout was remov'd.

In these things consists the whole method of cure by a milk-diet, as it was communicated by the above Baron *de Kopff*; and [by his example several great personages at *Prague*, *Vienna* and other places tried the same method on themselves, but not always with the same success. I know a certain nobleman in *Silesia*, about 40 years of age, very much afflicted with the gout, who was so far from receiving any relief from a milk-diet, that his body was swell'd and bloated to so very dangerous a degree, that he was oblig'd to lay it aside.

This method, therefore, is not indifferently to be applied to all constitutions. By way of conclusion I shall subjoin the judgment of *Gabriel Fonseca*, chief physician to Pope *Innocent X.* and the succeeding Popes; 'I have, *says he*, seen and perus'd the method of taking milk for the gout, to which nothing other seems to be wanting, since every thing is exactly describ'd, than that we examine and consider well the constitutions with which it may agree; and as to this I am of opinion, that if the gout proceed from a bilious, thin and hot matter, and from excessive heat in the liver, cows or asses milk is proper to be taken for 40 days successively; after which the patient may return to his ordinary diet, but which must be moderate: But if the gout arise from a cold cause, or a defluxion from the head, milk does not seem to be proper for such a complexion.'

Dr. *Job. Georg. Greisel*, physician at *Vienna*, has publish'd a treatise, entitul'd *Medicus de curâ lactis in arthritide*, wherein after having enquir'd into the nature of milk and of the gout, he at length by arguments and from experience proposes a milk-diet as the best method of curing the gout.

Besides this treatise, *Job. Jac. Wenceslaus Dobrzensky de Negroponte*, Professor at *Prague*, has promis'd to publish very soon a book of consultations of the several physicians of *Italy*, *France*, *Spain* and *Holland* about this method of curing the gout by a milk-diet.

Some Hints towards the choice and ordering of Cows for a greater increase of Milk, &c. From the Acta Literaria Sueciæ. Trimestre I. An. 1721. p. 137.

Translated from the LATIN.

Some observations about milk-cows and other cattle.

COWS of a red and black colour are preferable to such as are white; and of this last colour there should be but one, if possible, in a whole herd. Those call'd the *Dutch* breed and the larger sort of cows cannot.

cannot be sufficiently maintain'd in *Swedland*; but the breed, which we call mixt, may be had. Of these we are to chuse a bull, which is to be well fed and kept from coition till the third year; for, from too early coition, we have that baser and small breed, we usually observe. The first calves are to be rejected and even such as are calv'd after the twelfth year: The third, fourth, and fifth calves are the robustest and calv'd between St. *James's* day and *Lent*; for, such cows became with calf about *May* and *June*, the gayest season of the year: And in fine, such as have eight teeth in their jaw (but if ten) are by far the best. The teeth must be white, the breast broad, and the tail long, the veins of the belly distinguishable, the trace of the navel large, a broad forehead, and large black eyes, wide nostrils and rough ears. The principal care about the calves should be, that they be fed with the dam's milk with the longest possible; then you are to give them fine hay and a luke-warm drink made of meal, as also sour milk, whey and kitchen-wash. With their other drink you are to mix juniper-leaves boil'd along with the berries; and this is of excellent service; there are several good qualities conceal'd in this shrub; for, its leaves distill'd along with malt spirits, heighten them, and a decoction of the berries may serve instead of ale. The calves are to be kept in a warm coop; and their litter to be often shifted, that they may stand dry footed. You are likewise to provide against their being too much spent by the heat of the sun, and against their scouring by the new grass in spring-time: And for that purpose you are to use the leaves of the aspen-tree, the fallow and service-tree, as also nettles and other herbs, which you have gather'd beforehand. Their teeth are to be wash'd with salt and urine, and after a year they are to be accustom'd to chaff. The heifers are to be put apart, that they be not bull'd too soon; for, this is to be put off till the fourth year; but when they are bull'd, you are to set it down, that the housewife may know when she is to have new milk for her family. The bull is to be well fed, and salt at times to be given him. One bull is sufficient for 15 cows; but his vigour does not last above two years. Milk is a surprising work of nature, and far exceeding all our chemical distillations and sublimations. Over-fat cows yield less milk, but such as appear lean, and yet have plenty of milk, are the best; for these, therefore, you are to reserve your best hay. Chaff with oats may serve horses; yet so that one third of their fodder be hay, and given them in the night. Drinks made of meal, however, make horses short-winded, but in general, all cattle are fatten'd by the remaining phlegm of spirits of wine and grains. The farmer's principal care is to be employ'd on his pastures and meadows; and therefore, he is to sow in them the seeds of trefoil, angelica, pimpernel, cumin, and anise; but about the walls of the houses, and on the inside of the hedges he is to sow lovage. The hay should be cut down before its seeds fall off. Sour milk is

agreeable in summer-heats ; it is also of service in burning fevers, but the cream of milk is not so wholesome, before it is made into butter. The stalls should not be built in low places, nor be narrow, dark and dirty like so many prisons, but wide, spacious, bright and furnish'd with windows and shutters ; as the life of animals entirely consists in heat, yet suffocating vapours are noxious. Cattle are to be fed for the first time between 5 and 6 in the morning ; and again between 8 and 9, at which time they are to be brought out to water, and fed for the third time just at noon ; and in the evening they are to be water'd again, and then fed. Wooden curry-combs are to be us'd, especially on the approach of the spring, when they shed their hair, which, however, is to be sav'd ; for, of it coarser coverlets are made. Cattle ought to be encourag'd by the voice and by singing, with which they manifestly appear to be delighted. To milk-cows you are to give pure water plentifully ; but when near calving it is to be given them luke-warm. The birth is promoted by saffron, hemp-feed and the reddish coats of common onions and warm ale. After calving you are to give them a drink made of meal with a little salt. Rye-straw promotes the increase of milk ; but oat-straw dries it up ; and therefore it is fitter for sheep. Cows properly fed yield four pails of milk in 24 hours : And even in the province of *Scania* above that quantity. In the *Netherlands* they yield 8 pails, but then they must be carefully fed. You are to milk thrice a day in an equal and not in a slow and intermitting manner. Good milk stands upon the nail, but if watery it runs off ; and this defect is corrected by giving the cow salt ; and one pound of salt is to be given one cow in a year. Of salt-water and meal you are to make balls as big as eggs. From one cow you are to expect as many pails of milk as there are days in the year, to wit 365, but she must be well fed : It is, therefore, better to provide well for a few cows than starve a great many. As to the medicinal use of milk, it appears that even grievous distempers are removed by it. The milk may also be render'd medicinal if you give the cattle some sorts of herbs, which are commended and in daily use among our farriers.

Of a very simple kind of Micrometer. By G. Kirchius. From the Miscellanea Berolinensia. Tom. I. p. 202.

Translated from the LATIN.

A new kind of micrometer.

AFTER that in the last century the telescope was invented, occasion was thence taken of measuring small distances without the incumbrance of quadrants, sextants, octants, &c. to wit, such distances as the tube could take in. And 1. from the consideration of the moon the capacity of the tube is known, as for instance, when the tube could take in

in the moon's semidiameter, and a fixt star appear'd near any planet, which to the naked eye seem'd to be hid; yet by means of the tube it could be estimat'd how many minutes they were still distant from each other, namely, upon considering what part of the capacity of the tube, whether the third, fourth, sixth, or half, it then was, when the semidiameter of the moon was reckon'd at 15 or 16 minutes. Astronomers, afterwards not satisfi'd with a bare estimation, accomplish'd real divisions of the tube, to wit, by cross threads or wires, &c. and then they observ'd, how many such parts the moon (whose diameter was suppos'd to consist of 30, 31, or 32 minutes) contain'd; by which it was afterwards easy to compute, how many minutes such a small part of the threads constituted. But because all distances do not answer exactly to so many parts of the threads, and the remainder notwithstanding must be collected by bare estimation, hence they attempted to do the thing still more accurately; and for this purpose they employ'd screws, by help of which all distances, which a tube can take in at once, may be accurately measur'd; such an instrument, therefore, is call'd a *micrometer*; one kind of which is describ'd in the *Journal des Sçavans*, and another in the *Phil. Transf.* Besides these two, which are not made and adapted without some labour, I have devis'd a third kind so easy, that it may be very readily made by any lock-smith; for, on *January 17, 1679*, as I was observing *Saturn*, when retrograde, covering a certain star in the south horn of *Taurus*, I was desirous of knowing what his distance in his direct motion would afterwards be from the same star: And in defect of either of the aforesaid micrometers, I must set about one in a different manner; I, therefore, applied to a common lock-smith, and caus'd make me an iron-ring, which I might fit to my three foot telescope; this ring I divided with a pair of compasses into two equal parts; and there I order'd it to be furnish'd with screw-holes, into which I put screws, exactly answering to the holes, overagainst each other, but of such a length, that being screw'd in, they might touch each other: All which appears more clearly by the figure.

Fig. 4. Pl. IV.

As *Saturn*, therefore, by his direct motion approach'd to the above star, which on *January 17*, he cover'd corporally, I made *Saturn* appear in my telescope at the end of one of my screws near *a*; but I screw'd or unscrew'd the other screw to *b*, till the fixt star appear'd accurately at its end *b*; I afterwards screw'd one of them, for, it is no matter which; till they touch'd each other, and I told the number of turns; measuring at length the moon's diameter, I told the turns of the screw answering thereto; and then indeed, assuming the moon's diameter of 30 minutes, which is near the truth, *Saturn's* distance from the star might be easily computed: And this, therefore, was the first micrometer of the kind invented by me; by means of which, notwithstanding, I could reduce the distance into minutes by a three foot telescope, representing objects erect and consisting of four glasses.

The method of using it.

glasses. I afterwards caus'd make a brass ring with fine brass screws, that the observation might be the more accurate. But to attain to a greater exactness in the observations, I was not satisfied with numbering entire revolutions of the screw, but I also employ'd quarter-revolutions, as often as the distances requir'd them; and I, therefore, compos'd a table, from which I might compute the degrees or minutes, &c. of the micrometer answering to quarter-revolutions of the screw.

How to be fitted
to the telescope.

This micrometer, as also others, cannot be applied to any telescope at pleasure, but only to such a one as consists of convex glasses alone, as is well known, and the thing does not answer when the eye-glass is concave. When the telescope was first invented, namely, in the year 1609, it consisted of two glasses only, of which the eye-glass was concave, but the object-glass convex; by its means, therefore, distances could only be estimated according to the capacity of the tube; and such a tube *Kepler* must have us'd, when on *December* 14, 1627, N. S. he observ'd *Saturn* near a certain small star in *Virgo*, when they were distant from each other the sixth part of the capacity of his tube, which he estimates to two or three minutes: Such a tube, therefore, must only have taken in the moon's semi-diameter. After this a method was found of using a convex instead of a concave-glass, which indeed represents the objects revers'd, but may take in a much greater space; and tho', at length, a method is found of erecting again the objects by means of three eye-glasses; yet in viewing the heavens a tube that reverses the objects is rather to be employ'd, because we see more accurately by fewer glasses than by a greater number of them. But whatever be in this, whether the tube reverses the objects or not, it is no matter, providing the eye-glasses are convex; for, in that case the micrometer may be rightly employ'd. But the place, where it is to be fixt in telescopes, reversing the objects, is that, wherein the rays of the eye and object-glasses, or the rays of vision, intersect each other, or rather where they converge into one point, or in the common focus of both, that is, at that distance from the eye towards the object-glass, which is the distance of the eye-glass from the eye. In this place the screws of the micrometer are accurately and distinctly seen in their just magnitude; and near the said place making a small hole in the tube a pin may be fixt, and the pin bent from or towards the eye, and thus you may try which is the properest place of seeing the point of the pin in the distinctest and clearest manner; and then in that place the iron, or brass-ring, may be externally applied to the tube, and taking out the screws small holes may be made in the tube corresponding to those of the screws; and then the screws may be screw'd in, after which you will have every thing fit for your purpose. The ring also, if it is necessary, may be firmly fasten'd with two other screws, that by its unsteadiness the observation be not marr'd, or the screws spoil'd. In telescopes that erect the objects, the micrometer is plac'd in the

he middle between the two former eye-glasses, or in the focus of the first ye-glass.

Of the culture of Tobacco, and the planting of Madder; as also of Cole-worts in Silesia. From the Breslaw Collection, October 1717. Class III. p. 194.

Translated from the HIGH-DUTCH.

TOBACCO (which is an *American* plant, and particularly growing in *New Spain* on the island *Tabacco* or *Tabasco*, afterwards call'd the island of *B. Maria Victoriousa*) was about 1520 first brought to *Lisbon* by *Francisco Hernandes de Toledo*, who, by the command of king *Phillip II.* was sent to *America* to write the natural history of that country, which he did in XVII Tomes, entitul'd *de Americanâ historia naturali civilique*, after the expence of 60,000 ducats; and in the library of the *Escu-rial* this work is still to be seen very beautifully done, in which all the figures, and those barely of plants to the number of 1200, are painted in their natural colours. From this work at length *Nardus Antonius Recchus*, by order of the said king *Philip*, made an abridgment, which, with several additions, was publish'd at *Rome* in 1651, in X books in *Folio*. From *Lisbon* tobacco was sent by the *French* ambassador *Joh. Nicot* in 1559 to *Paris*, or according to others and the author himself, it was sent thither in 1556 by *Andr. Thevet* out of *Brazil*; but from *Paris* it was directly sent by the legate *Nicol. Tornabonius* into *Italy* to the bishop *Alphonsus Tornabonius*; and from the pope's *Nuncio*, the cardinal *de Santa Cruce*, it was sent from *Lisbon* to *Rome*; but it was brought to *England* by *Richard Greenwil*, who in 1585 was sent to *Virginia* by orders of queen *Elizabeth*, and at the expence of Sir *Walter Raleigh*: And hence arose both the use of smoaking tobacco (which was first learn'd by the marinêrs in *America*, and afterwards by them made known to the *Europeans*) as also the planting of tobacco, which spread in *Holland*, and from *Holland* in *Germany* far and near: So that at this day this plant is wont plentifully to be propagated about *Bremen*, *Hanau*, *Hesse*, *Francfort* on the *Oder*, in the territory of *Magdeburg*, and particularly about *Magdeburg* and *Hall*, as also about *Dessau* and other parts; and lastly, also in *Silesia*, and chiefly in the Dutchy of *Brieg*, about the little town of *Wanssen*, *Bore*, and at this day even about *Breslaw*, as also near *Neumarck*, and in other places.

Tobacco when first known in Europe.

Of the culture of tobacco at *Wanssen* we had the following account, communicated to us by a learned friend. 'Asearly as possible in the spring, commonly in the month of *March*, after the full of the moon, the seed, which pretty nearly resembles that of marjoram, only that it is a little bigger, is sown: :'

Culture of tobacco.

' sown: Some, it is true, sow it in harvest, in order to have the plants
 ' the sooner ripe; and yet they come not nearer to their purpose than
 ' those who sow it betimes in the spring. Glass-beds may be of great ser-
 ' vice in this case; so soon as the plants become no bigger than that one
 ' can lay hold of them, they are transplanted as other plants usually are,
 ' and the sooner this is done the better the tobacco ripens: But when it is
 ' very dry weather the plants must be stronger, and even a finger in length.
 ' The ground is broke up with grubbing axes, and then each plant has a
 ' little tump made round it, so that the root may have moisture for its
 ' better growth. Firm black bottoms, as about *Wanssen*, where the ground
 ' is so hard, that if it happens not to rain in 14 days, there is no breaking it
 ' up, must be the oftner dug, a thing not necessary in looser soils; this digging
 ' must not be perform'd in dry weather, that the earth may not become
 ' loose, and consequently the drying of it up be the more promoted; but
 ' it is usually perform'd when it has rain'd the day before. The transplant-
 ' ing is in the months of *May*, *June*, and *July*: Those set late prove seldom
 ' good, as the leaves cannot be well ripen'd: Those that are first planted
 ' ripen best; and hence they taste more agreeably, to which contributes
 ' very much the breaking off the middle sprout, that the vegetative juice
 ' may rise into the leaves, whereby they become long and thick, as also
 ' of a more agreeable taste, but before this is done the plants are suffer'd
 ' to grow up, till they have about 10 or 12 leaves, or till they are about
 ' two ells high: But where this operation is not perform'd, they have, it is
 ' true, more leaves, but they remain small and taste bitter; and this is the
 ' reason why most of the tobacco of *Wanssen* tastes ill; but as by this
 ' breaking off the sprout the seed is lost, you must leave some untouch'd;
 ' for, tho' the middle stalk remains, the seed that grows thereon is not fit
 ' to sow, but of it oil is made. When the flowers, which are somewhat
 ' of a lighter colour than those of peaches, are ready to fall, they must be
 ' taken off; for, when they remain lying on the leaves, and it happen to rain
 ' thereon, they get holes, tho' also it usually blooms for a long time after
 ' the lowest and best leaves are taken off. The flowers are of different
 ' colours; some of a light blue, as the tobacco itself hereabouts is not always
 ' of the same colour. The seed comes first to ripen after *Michaelmas*; its
 ' oil is prepar'd in the same manner, as that from lintseed; namely, it is
 ' dry'd, stamp'd, warm'd, and lastly press'd: Its use consists herein, that
 ' it is burnt in lamps, and it yields no smoke. A quarter of this seed yields
 ' from 5 to 6 and 8 quarts of oil. As to the leaves, they do not all be-
 ' come equally ripe, but the lowest ripen first; and they are yellow, and
 ' then pick'd off; and this is commonly done in the full of the moon.
 ' Harvest-times are very prejudicial to this plant, and render it bitter.'

Lesian madder.

Silesia is among other vegetables remarkable for madder, which is pro-
 duced plentifully in that country, particularly about *Breslaw*; and at this
 day

day in several parts of the country, as well in the territory of *Breslaw*, as in other principalities: So that in *Breslaw* alone there is yearly sold 70,000 stone. It is not propagated from the seed, but by sets, which are taken up early in the month of *May*, after they have shot high and yielded leaves, and are laid thick on one another cross-wise in rows, in the small furrows of a well prepar'd field; and after four weeks, in the month of *June* they are dug up for the first time; and in the month of *July* laid deeper in new furrows, and cover'd with mould, that the eye of the stalk may strike new root, and thus the madder be multiplied; upon which then the earth is once ho'd and clear'd of weeds: But lastly, in the month of *October*, the plant is cut off and the root thrown up, yet so that a part thereof with the plant is left all winter on the field, which the following spring must serve for new sets. The culture of this plant may be seen in a book, entitul'd the *Silesian Husbandry*^a; and from this author in *Paul Marperger's Silesian Merchant*^b. Now this madder, according to the time of throwing or digging it up is twofold, as shoot-madder and harvest-madder; of which the former are such roots, as after taking off the shoot-plants remain over in the spring, and it is reckon'd preferable to the harvest-madder, which last is especially in the month of *October* taken up, dry'd and beat into powder. This useful plant, besides its medicinal virtues, is highly serviceable in dying. In the warm and pretty moist weather of this present year, viz. 1717, the madder turn'd out entirely good, yet better in one field than another, and best of all in sandy soils, where, namely, to the fat bottom some sand is mix'd. In too fat, black, and moist bottoms, on the contrary, it proves not so good as in the former, as being more woody and strawy, as also its roots smaller and not so substantial, and as being grassy: Whereas, on the contrary, sandy soils yielded a thicker, larger, fatter, and purer madder; and this was ascrib'd to the wet weather in *July* and *Aug.* which was of service in sandy bottoms, but in fat soils the madder run more into leaves and grass than into roots; and here and there it rotted. We commonly observe, that when the madder in moderately dry and warm harvest weather shoots well, and a good winter ensues, so that the slips are not kill'd by the frost, that the increase of madder the following year is usually very good; but it principally requires a fat and black soil, or at least mixt a little with sand.

Among the most useful plants cabbage is the principal, as there is not only a great consumption of it in its natural state, but as it is much us'd for pickling. *Brueyerinus*^c entirely rejects the common method of over-boiling coleworts and rather recommends parboiling them, and then seasoning them with salt and oil, whereby the herb not only retains its beautiful green colour, but also acquires an agreeable taste; and this method was also us'd among

^a *Lib.* 1. *p.* 127.

^b *Cap.* 8. *p.* 303.

^c *De re cibar. Lib.* 8. *cap.* 9. *p.* 366.

among the ancients ^d. As coleworts in particular were greatly us'd among the *Greeks* and *Romans*, so *Chrysippus* has writ a particular treatise in praise of this plant: And as among the *Romans*, *Cato*, *Columella*, and others thought they could not praise it overmuch, so it was given out, that the *Romans* had for 600 years no other phyfic than this vegetable; which the above *Brucerinus*^e would not have to be taken strictly, but only that the *Romans* from their simple way of life and frugality made use barely of herbs; and among these of coleworts in particular, and continu'd healthful without any use of medicines. But that the *Romans* were particularly curious as to this plant appears among other things from the different species of it among them, which are no longer clearly known in our days, as the *Brassica Aricina*, *Pompeiana*, *Sabellica*, *Brutiana*, *Cumana*, *Tritiana*, &c.

A method of preserving coleworts and cabbage from mildews and caterpillars.

We think proper to add here the following experiment communicated to us by a learned farmer in *Silesia*, whereby coleworts and cabbages are preserv'd from poisonous mildews, and more happily escape caterpillars; 'Take the colewort and cabbage-seeds, steep them in a mixture of foot, ' *aqua vitæ*, and human urine, in equal quantity, let them stand for half an ' hour, afterwards dry the seeds in the sun, and then sow them.'

^d Apicius Coelius *de Obscon. & condiment. ex edit. Listeri Lib. 3. cap. 1. p. 71. e l. c. p. 365.*

A twofold direct method of dividing a Semicircle in a given Ratio, whereby Kepler's problem about finding the places of the Planets at any given time is solv'd. By Jac. Hermann. From the Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 142.

Translated from the LATIN.

The problem as propos'd by Kepler.

1. **K**EPLER, as far as I know, first taught, that the path of the planets is elliptical; and that each of them revolve in its orbit, so as to sweep area's proportional to the times. These beautiful discoveries, drawn from *Tycho's* observations by an artful *calculus*, and exactly agreeing with later observations, have given a quite new face to astronomy; but there offer'd therein a difficult problem to be solv'd, to whose solution *Kepler* had no direct way, and which he was, therefore, oblig'd to attempt by that call'd the *rule of false*. *Kepler*, at the end of his commentary on the planet *Mars*^a, expresses the problem in these words: 'The area of a part of a semicircle being given, as also the point of the ' diameter, to find the arch and the angle at that point; by the legs of ' which angle, and by which arch the given area is comprehended.' Or, 'From any point of the diameter to cut the area of a semicircle in a given ' ratio.' Subjoining, it is sufficient for me to believe, that it cannot be solv'd *à priori*, because the arch and sine are heterogeneous.

^a *Part. 3. f. 300.*

2. The

2. The first, as far as I know, who attempted to merit the fame of the great *Apollonius*, was Sir *Christopher Wren*, who really attempted the direct method, and constructed the problem by means of the protracted cycloid; for, Dr. *Wallis* has publish'd his construction at the end of his treatise on the cycloid: But whether he has strictly taken the method, which *Kepler* required, I very much doubt; for, Sir *Isaac Newton*^b, who has repeated almost the same construction, own'd, that on account of the difficulty of describing this curve, it was better to employ a solution by approximation, such as he has exhibited by a converging series of angles: And yet I know not whether it be expeditious enough. Dr. *Gregory* and *Keill* have, as in other things, so in this imitated the illustrious author; for, both of them have given a solution of *Kepler's* problem by an infinite series, the latter in his *Astronomical Lectures*, and the former in his *Geometrical Elements of Astronomy*. *Phil. de la Hire* and *Jac. Cassini*, men who have deserv'd greatly of astronomy, applied themselves to the solution of this problem without the use of series, and they have publish'd their solutions in the *Memoirs of the Royal Academy of Sciences* for the years 1710 and 1719. There appear'd another by *Peter Horrebow* in Tom. IV. of the supplements to the *Acta Erudit. Lips.*

Its solution attempted by several.

3. It will, probably, appear superfluous again to attempt a problem, after solutions of it by so many great men. Yet I shall venture upon it, since different methods of solving one and the same problem are not without their usefulness. My method is twofold; the one purely geometrical, and the other arithmetical and more accommodated to an astronomical calculus. The problem is this;

A twofold manner of solution by the author.

The geometrical solution.

To divide the semicircle *AQD* by the line *BE*, so that the trilinear figure *ABE* be to the semicircle *AQD* in a given ratio of *DN* to *DH* = *AD*.

Problem. Fig. 5. Pl. IV.

In the semicircle *DGH* = to the other *AQD* inscribe the *quadratrix* *DLGH* of such a nature that from any point thereof *L* drawing the lines *LK*, parallel to the diameter *DH*, and *LM* perpendicular thereto, the corresponding arch of this division, namely *DK*, be always to the *abscissa* *DM*, as *DKG* to the radius *DI*; then take in the radius *CK*, produced upwards and perpendicular to the diameter, *CP* = to the quadrant *AQ* and join *PE*; but from the point *N* draw the line *LN* parallel to the other *EP*, meeting the *quadratrix* any where in *L*, from which point afterwards drawing *LB* parallel to the diameter *AD*, it will meet the semicircle *AQD* in the desir'd point *B*; for, joining *BE*, the triangle *ABE* will be to the semicircle *AQD* in the given ratio of *DN* to *DH*.

Construction.

For, from the nature of the line *DLG*, *AB* (*DK*) is to *AQ* (*DG*) as *DM* to *AC* (*DI*) and therefore *AQ* × *DM* = *AB* × *AC* = 2 sect. *ABC*. On account of the parallels *PE* and *LN* the triangles *PCE* and

Demonstration.

B b 2

LMN

^b Princip. phil. Nat. lib. 1. prob. 31.

LMN are similar, and give CP (by construct. AQ) to CE as LM (BF) to MN; wherefore, $AQ \times MN = CE \times BF = 2 \triangle CEB$, and by addition $AQ \times DM + AQ \times MN = 2 \text{ sect. } ABC + 2 \triangle CBE = 2 \text{ trilin. } ABE$; wherefore, $AQ \times DN = 2 \text{ trilin. } ABE$; and 2 semic. $AQDA = AQ \times AD$ or $= AQ \times DH$; wherefore the trilinear figure ABE is to the semicircle AQDA (as $AQ \times DN$ is to $AQ \times DH$) as DN to DH. Q. E. D.

DLG is, indeed, a transcendental curve, seeing it is a species of the line of fines; yet it is the more rightly applied to the construction, as it may be more easily describ'd thro' points than the protracted cycloid; for, by the continu'd bisection of the quadrant DKG and of its parts, so many points of the curve, and those so near to each other, may be found as you please, only drawing thro' each division of the quadrant lines parallel to the diameter, and thro' the like divisions of the radius DI lines perpendicular to the same diameter; the meeting of these perpendiculars with the diameter and their parallels furnish so many points of the curve.

I said, that the curve DLG is a species of the line of fines; for, LM is the sine of the arch DK, and DM is proportional to this arch: Wherefore the *abscissæ* DM represent the arches, and the ordinates LM their sines; and for this reason, the curve DLG is the line of fines.

This curve, which others call *Tschirnhausen's quadratrix*, because mention is made of it in *Tschirnhausen's medicina mentis*, where some of its properties are rehears'd; this line, I say, has an excellent use in the constructions of those problems, which depend on circular arches, which this very construction of *Kepler's* problem shews.

The arithmetical
solution.

4. The given construction also supplies us with the arithmetical solution of the problem; for, calling the arch $AB = a$, the radius $AC = r$, the sine of the arch $BF = s$, the quadrant $ABQ = q$; and in fine, $DN = b$, and $CE = e$, on account of the curve DLG it will be $DM = \frac{ar}{q}$; but the similar triangles CPE and MLN give $MN = \frac{es}{q}$; wherefore, since it is $DM + MN = b$, it will be $\frac{ar + es}{q} = b$, or $ar + es = bq$.

But by what *Leibnitz* has prov'd in the *Acta Erudit.* ^c from the differential calculus, and by what I have deduced on occasion of the angular problem by common geometry ^d it is $s = a - \frac{a^3}{6r^2} + \frac{a^5}{120r^4} - \frac{a^7}{5040r^6} + \text{Ec}$. Wherefore, substituting this value of the sine in the equation above found, to wit, $ar + es = bq$, we shall have $r + e \times a - \frac{a^3e}{6r^2} + \frac{a^5e}{120r^4} - \frac{a^7e}{5040r^6} + \text{Ec} = bq$.

If now in this series all the terms except the first be suppos'd to vanish, there will result $e + r \times a = bq$, that is, this analogy $AE : DN :: AQ : AB$, which analogy now yields a commodious approximation of the arch AB.

But

^c *An.* 1693. p. 179.

^d *Ibid.* *An.* 1703. p. 351.

But if two, three, or more of the first terms of the series be assum'd, there will arise equations of three, five, seven, &c. dimensions, which, indeed, do not seem proper for astronomical use: Wherefore, I proceed to the arithmetical method of solving this problem.

5. Let the arch AM express the mean anomaly, and let CE be the excentricity, and join ME; and drawing from the centre C of the semicircle the line CN parallel to EM, let EN be drawn; I say, that the angle AEN is the coequate anomaly very nearly. But this anomaly will be found more accurately, if now the arch NM be call'd a and the radius AC = r , and if it be $x = \frac{a^2}{6r^2} - \frac{a^4}{120r^4} + \frac{a^6}{5040r^6} - \text{&c.}$ And the angle NEB = $\frac{CN \times ax}{BE^2}$, the angle AEB will be the coequate anomaly. Fig. 6. Pl. IV.

For, the trilinear NEB will be = to the segment of the circle, contain'd between the arch NM and its subtense; wherefore, since the triangles NEC and NMC, constituted on the same base NC, and between the same parallels NC and ME are equal, the sector AMC will be = to the trilinear ABE; but the sector AMC is to the semicircle AMDA as AM to AMD; therefore also ANBE is to the semicircle AMDA as AM to AMD, that is, in a given ratio. Q. E. D.

As to the angle BEN it will be found from this, that the segment of the circle between the arch MN and its chord MN should be equal to the sector BEN: Now that segment is equal to half the product of the difference of the arch MN, and its sine into the radius CN; but since the arch MN (by hypothesis) is a ; and its sine = $a - \frac{a^3}{6r^2} + \frac{a^5}{120r^4} - \frac{a^7}{5040r^6} + \text{&c.}$ the arch MN — its sine will be = $\frac{a^3}{6r^2} - \frac{a^5}{120r^4} + \frac{a^7}{5040r^6} - \text{&c.}$ (that is, because $x = \frac{a^2}{6r^2} - \frac{a^4}{120r^4} + \frac{a^6}{5040r^6} - \text{&c.}$) = ax . But the sector BEN is equal half the rectangle of NE $\times$ Bb, letting fall the perpendicular from B on EN; for, the sector on account of the smallness of the angle BEN may be consider'd as a rectilinear triangle; and the perpendicular Bb as the small arch describ'd from the centre E with the radius EB; but as the segment MN should be equal to the sector BEN, it will be EN $\times$ Bb = $ax \times CN$; and therefore, the small arch Bb = $\frac{CN \times ax}{EN}$: But as EB to the arch Bb, so the radius CN to the angle BEN = $\frac{CN^2 \times ax}{EB \times EN}$ or because EN and EB may be consider'd as equal, the angle BEN will be equal to $\frac{CN^2 \times ax}{EB^2}$, as was laid down.

With Keill let CE = 0,01691, AC being equal 1, the coequate anomaly AEB is sought, if the mean anomaly AM = 30°; wherefore the angle ACM = 30°; and in the triangle MCE, the angle MEA will be found = NCA = 29° 31' 38" = the arch AN; wherefore NM = 28' 22": But in the triangle NCE the angle NEA is found = 29° 3' 7", and this

Example.

is the coequate anomaly ; for, the angle NEB will not be equal to $4^{\text{'''}}$; and therefore it does not deserve to be regarded.

Example.

In fine, let it be said, as the sine total to the sine of the angle PCE (namely erecting in E a perpendicular to AD) so is the tangent of the angle found AEN or AEB to the coequate anomaly in the *ellipsis*. Keill by his series found the angle AEN such as we have obtain'd it here without any series by the sole resolution of the two triangles MCE and NCE ; for, the use of the preceeding series has only shown to me what should be the quantity of the angle NEB to be added to NEA now found : But as by calculation it is found not to amount to $4^{\text{'''}}$, it is deservedly overlook'd.

An Observation and Experiments about the external Use of Spirits of Wine in stopping Hemorrhages. From the Acta Eruditorum Lips. An. 1683. p. 153.

Translated from the LATIN.

The stiptic quality of spirits of wine, and the experiments made therewith.

N O one, who is not regardless of the physical and medical discoveries of this present age, is ignorant of the use of that stiptic liquor, some years ago discover'd by one Vivient, a French colonel, and which has been so famous in France, England, Denmark, Germany and other parts, that after various trials made of it, King Charles II. purchased the manner of preparing it at 5000 crowns. Most people conjectured, that this medicine consisted of vitriol and alum, but with what truth we shall not now enquire ; tho' the liquor itself (which about 8 years ago I had from a certain gentleman, who solemnly averr'd, it immediately came from the inventor himself) discover'd by various circumstances the above ingredients. But as several people at that time affirm'd, that it exerted its stiptic virtue by rendering the blood grumous, and by that means stopping up the wounded or lacerated vessels ; and as I myself also happen'd to observe the like *phenomenon* upon its application, I began to think, whether spirits of wine might not have the same effect, that is, whether they might not stench a flux of blood ; for, it was what other people observ'd as well as myself, that that sulphureous spirit coagulates or makes the blood highly grumous, which it receives in a very fluid state from a vein, and makes it resemble compacter flesh, not to mention the coagulating power it also exerts on the bile, as we learn from mechanics : This theory of mine will not, therefore, be reckon'd entirely paradoxical, whereby in the same manner I conjectured it would probably also act on the vital blood, that is, coagulate some portion thereof, and hence stop hemorrhages in wounds even of the larger vessels ; but as I here found, that

that bare reasoning without experience is like a ship without a pilot, expos'd to an ocean of doubts, I for this purpose made several experiments on dogs; and that not only on the smaller vessels, as those in the leg, but likewise on the larger vessels, as the crural and jugular, both veins and arteries; sometimes I cut the artery alone, and sometimes its social vein at the same time, now lengthwise, and again transversely; and by applying only the spirits of wine, they were in a few minutes clos'd up, and the blood stopp'd; and the event always answer'd my expectation: And tho' I remember I did not use one and the same method in cutting asunder and tearing the vessels, nor in applying the stiptic; yet by repeated trials I would not begrudge to remove every doubt, and thereby examine each circumstance; and in the operation I observ'd the following methods; 1. I carefully remov'd the external integuments, as the skin with the fat and muscles, which sometimes stood in the way, that the vessels to be cut asunder might be laid bare; and that neither the bulk nor the contraction of these parts might by compressing, obstructing, or in any other manner stopping up the vessels, after they were once opened, effect what I had ascrib'd to my liquor. 2. I cut the vessels oftner lengthwise, more rarely transversely, but least their extremities, being either corrugated by their own proper contraction, or compress'd by the adjoining parts towards which they are retracted, should without the use of any medicine suppress the hemorrhage; as I here suppose it well known from surgery, that it proves a remedy in the hemorrhage of vessels, lacerated in the muscular parts, after all other means prove ineffectual, to cut them asunder transversely; yet 3. I made these fissures pretty long; and very lately in the external jugular vein, which in a dog is far larger than the internal one, I made a fissure of a fingers breadth, and yet with the desired success. 4. In the application of the spirits of wine I managed it so, that I first let some blood run, to show that the vessel was really open'd: Hence, without any compression, either of the artery in its upper part, or of the vein in its lower part, I laid upon the wound a compress, sometimes single, sometimes double, drench'd in the liquor, pressing it down with my own fingers, or with those of the assistants in the gentlest manner, that is, no harder than is usual in feeling the pulse. 5. And after stenching the blood, I sometimes applied the same bolsters, drench'd a-new in the spirits with proper rollers; and I took care to keep the animal quiet for some hours, yet oftner I let him go without any bandage; and I never observed so much as a drop of blood, did he roll himself or walk, &c. in any manner whatever. 6. And lastly, I never continued the compression, nor the application of the liquor above a quarter of an hour, as those who assisted me in these experiments can testify; nay, I remember I have often let the animals go in a few minutes after. I always found the more dephlegmated spirits to produce the quicker effect.

But

How spirits of
wine produce
their effect.

But being satisfied as to the truth of the experiment, I resolv'd to enquire into the manner of the operation; that is, whether the spirits, as I, indeed, formerly thought, produced their effect by coagulating the blood, or rather by constringing the vessels; and upon removing the pledgets I scarce ever remember to have seen any coagulated blood about the wound: But I shall relate what a few days ago I found in a dog, the trunk of whose crural artery just under the *abdomen* I open'd; and after closing it, I open'd the external jugular vein, after which I immediately caus'd strangle the dog. In three hours after, having sufficiently view'd the wound, after it was clos'd up and observing no grumous blood about it, I enter'd a probe thro' the upper part, and which lies within the *abdomen*, to try whether passing it downwards to the lower parts, it would not open the wound of the vessel; but tho' I mov'd it upwards and downwards, yet this happen'd without tearing the vessel, as I was apprehensive. I open'd the lower part of the same artery, that by it the knob of the probe might come out, which yet protruded no grumous blood: Hence I cut the affected part itself, which was harder and of an obscurer red than the rest of the artery, and I neither found in its lips or channel any grumous blood. The wound of the jugular vein was opened, yet without any grumous blood externally, by hastily putting in the probe at the upper part, which was probably owing to the far shorter application of the spirits to it than to the said artery, or that its substance was much thinner, or that the instrument was too forcibly driven in; and thro' the wound there also came out along with the fluid blood a little coagulated blood, which I would have suspected to be owing to the spirits of wine, had not I myself and the assistants directly observ'd the like *moleculæ* of blood in other veins of the internal parts, as in the *vena portæ*: I also put a probe, (moving it from above to their extremities) into the right crural arteries and veins of another subject, which were cut transversely, and in a few minutes consolidated: And in these I observ'd a remarkable narrowness, as they admitted the instrument with some difficulty; nay, its knob being protruded thro' the aperture, seem'd to carry along with it a kind of thinner *membranula*, probably, like to that very thin pellicle, which the *Acta Hassniens.* mention, as produced by the *French* stiptic in the wounds of vessels: Besides, the spirits of wine do not directly render the blood grumous; on the contrary, by a momentaneous contact, as it were, they cause a remarkable firmness, nay, in tract of time, a hardness in the more solid parts of the body, as the flesh, the substance of the brain and liver, the nerves, &c. namely by constringing their fibres, and instead of relaxing, making them denser. And now about four years I keep in my *museum* a heart taken from a human subject, which, after lying in simple spirits of wine for some days only, acquir'd almost a bony solidity; and is therefore, still without any signs of corruption, so that we may probably conjecture,

conjecture that this liquor does by constringing or condensing act rather on the vessels than on the blood, and thus stench hemorrhages; which will seem less paradoxical to such as are apprised of its great virtue in consolidating wounds and removing gangrenes.

A specific in the Pleurisy. By. Dr. Petr. à Castro. From the Miscellanea Naturæ Curiosorum. Obs. X. An. I. Dec. I. p. 29.

Translated from the LATIN.

TAKE citruls, a species of pompions, hang them in a close place out of the sun's rays, cut them into pieces, throw away the pulp, save the peel and separate it well from the pulp, so that the peel be no thicker than a crown piece. Take of this peel 1 lb. of the oldest oil-olive (of 10, 20, nay, if possible, 100 years old) 3 lb. in this oil boil the peel, till all its humidity is consumed; and it is a sign of its being well boil'd, if a straw, dipt into the oil and applied to a burning candle, takes fire without hissing, as also if the peel appear almost burnt, and as it were, reduced to a coal; then cease boiling, strain the oil, and after that take an iron-pot with two orifices, or at least one in its side for the oil to pass thro'; make the pot red hot and pour the oil into it thro' the one orifice, that it may come out at the other into a vessel, set below to receive it, and this oil is to be us'd for anointing the ailing side.

The method of preparing this specific.

Dr. Petrus à Castro, famous for his successful and frequent practice, first in *Biscay* in *Spain*, and then in *Verona* in *Italy*, and afterwards in the station of chief physician to the Duke of *Mantua*, did by this specific perform extraordinary cures on pleuritic patients, of whom there is a great number in *Italy*, both on account of their temperament, as also on account of the climate and air, and snatch'd them even from the jaws of death.

The success of using this specific.

After the Dr's death, which happen'd about nine years ago at *Mantua*, a certain person at *Ferrara*, well knowing the great usefulness of this remedy, thought fit not only to publish it to the world, but to send printed copies of it to the more noted hospitals of *Europe*. A like copy was printed at *Ferrara* in 1669, with the licence of the superiors, by *Alphonf.* and *Job. Baptista Maresti*, and sent to *Breslaw* in 1670 to St. *Matthias'* hospital, which was communicated to me, and is as follows;

The manner of publishing it to the world.

I *N. de N.* who have experienced the extraordinary virtue of a certain oil, which in a few hours cures the pleurisy, have for many years past cur'd all such patients as made use of it; and that to the surprise of the physicians, so that it never fail'd: I, therefore, thought it honourable, nay, a work of very great charity, if I should publish the said secret, to

wit,

wit, the manner of preparing and applying the above-mentioned oil and communicate it to all the hospitals of *Italy*, nay of *Europe*.

Another method
of preparing the
above specific.

Take citruls after they are grown to a due bigness and that for this reason, that they may not be too hard, but at least of such a thickness, that they may take in the oil; scrape them as you do radishes; but take care you do not pare them as you do apples, only scrape them and take off that thin pellicle which covers them, and whereby they appear green; after this cut the citrul lengthwise, quite round, into slices as thick as a crown piece, after which weigh the slices, clearing them internally from the pulp, and take the same weight of oil-olive; the better the oil is, the more serviceable it will prove; and if your peel weighs two pounds, you must take as many pounds of the oil, and consequently, the weight of the oil must be always equal to that of the peel. After this put the oil and peel into a new and pretty strong earthen pan, for the reason hereafter to be mentioned, and let them boil over a coal or wood fire, providing there is no flame, till the pieces of the peel become entirely dry, and, as it were, burnt up; then take it out of the oil with a spoon and throw it away, because it is of no use; then thro' the oil pass heated iron, (and not steel) never before us'd, and that for 17 or 18 times, heating the iron well every time: And I myself proceed in the following manner; I cause the pan with the oil to be carried to a smith's forge, and I order to be put into the hearth six pieces, somewhat bigger than half a palm, of virgin iron, or such as has not been us'd before; and when they are red-hot, I put one after another and quench them in the said oil, and then I throw the iron again into the fire, and when I have repeated this three times, as there are six irons, this will make 18 times, which is sufficient for giving the oil its perfection.

I never prepare less than 8 or 10 pounds of it, but you may make a greater or less quantity of it at pleasure, provided you take as much oil as peel. But as the red hot iron put into the oil, is apt to cause it to take fire, you must have at hand a lid to cover the pan and extinguish the flame; but as it may also happen, that the suppress'd flame may burst the pan; I, therefore, hinted above, that you must use a stronger pan; and I myself, for the greater security, before the ignited iron is put into the pan, put the pan into another earthen vessel for fear of losing the oil, should the pan break in the operation. When the oil is cold I pour it into a glass bottle and keep it for use.

The method of
using this oil.

Take a little of this oil on a plate, and heat it well, so as it may be bore, and pour the oil on the part and anoint it; then take a dirty towel, which has been us'd, and fold it four times, and also heat it as the patient can bear it, and lay it on tow and fasten it, lest by its motion the oil should shift from the part affected; and because sometimes the pain is also

also communicated to the other side, that is also to be anointed in like manner, and the row and towel to be laid on: And because sometimes the pain moves from one rib to another, continue to anoint wherever the pain shifts; and if the patient, when anointed in the said manner, does not begin to spit, renew the inunction five hours after, but rarely is there occasion to repeat it, seeing we find by experience, that the imposthume breaks in a few hours. Thus far the *Father*.

The description of this oil differs but little from à *Castro's* preparation, Remark thereon. yet agrees with it in its virtue; and for its usefulness should be introduc'd into the shops.

Of the Situation of Scythia, such as it was in Herodotus' Days.

By T. S. Bayerus. *From the Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 400.*

Translated from the LATIN.

O *Nomacritus* and *Æschylus*, are the first of all the *Greeks*, whose works are now extant, that writ any thing of the *Scythians* after the arrival of *Anacharsis* the *Scythian*, into *Greece*. This *Anacharsis*, as *Herodotus* testifies, was the son of *Gnurus*, and brother to *Saulius*, king of the *Scythians*: *Gnurus* was the son of *Lycus*; *Lycus* the son of *Spargapithis*; tho' *Lucian* in *Scythia* calls his father *Daucetus*, and not *Gnurus*, but from what authority I know not: And *Diogenes Laertius* calls his brother *Caduides*. He came to *Athens*, according to *Soficrates*, the *Rhodian*, and the ἀναγραφή Ολυμπιαδων in the first year of XLVIII olympiad, when *Eucrates* was *Archon*, who by one year succeeded *Solon*, 17 years after the *Scythians* lost their sovereignty in *Asia*, and were engaged in the *Servile war* at home; from which I think it happen'd, that none of the affairs of the *Scythians* were so famous in *Greek* story, as what they had heard from *Anacharsis* of their late civil war. *Anacharsis* had a *Greek* to his mother, or, to give credit to *Diogenes Laertius*, that he spoke *Greek*, rather than to *Lucian* and the fictitious epistles of *Anacharsis*, that he only understood the *Scythian* language. Yet it seems that the situation of the places in *Scythia* could not hitherto be very clearly known. And *Anaximander*, the *Milesian*, being about 20 years of age, could have known *Anacharsis* in *Athens* or some other city in *Greece*. He is reckon'd by *Agathemarus*^a among the first who made geographical maps: And probably from him *Onomacritus* borrow'd his accounts, when in the LXV olympiad he publish'd his *Argonautics* at *Athens* under *Orpheus'* name. *Pindar* has, indeed, mentioned, that *Abaris*, whom some suppose to have been a *Scythian*,

At what time the *Greeks* came acquainted with the *Scythians*.

C c 2

others

^a p. 1. Ed. Hudson.

others an *Hyperborean*, came to *Athens* about the time of *Cræsus*; but he seems to have had *Anacharsis* in his view, who was at *Athens* much about that time: And I doubt not, but that *Eusebius* and *St. Jerom* were misled by his authority, when they hold, that *Abaris* came from *Scythia* to *Greece* in the second year of the *LIV* olympiad, and in the beginning of *Cræsus*' reign. *Hippostratus* contends, that he came thither in the *III* olympiad, others in *Harpocratio* in the *XXI* olympiad; nay, *Firmicus Maternus*, as *Joseph Scaliger* and *Mauffacus* have corrected him, makes him cotemporary with the *Trojan* war: But in those days the *Scythians* could not be known; so that with *Herodotus*, *Harpocratio* and the *Scholiast* on *Aristophanes*' *Ἰππείων*, I would rather chuse that *Abaris*, the *Hyperborean*, was meant and trace him from the *Greek* colonies sent to *Pontus*; which *Hyperboreans* I suppose sent sacrifices and ambassadors to *Delos* and *Athens*, as I shall hereafter show in another dissertation; unless *Herodotus* in his *Melpomene* is rather to be credited, who says that this *Abaris* is a groundless fable. No *Scythian*, however, seems to have accompanied *Anacharsis* into *Greece*, if his brother out of his hatred to a foreign religion slew him with a dart, as he was assisting at the sacred rites among the *Greeks*: Tho' I am not ignorant, that there are other authors who make *Anacharsis* to have liv'd to 100 years of age. There are many trifling and silly things in *Onomacritus*, whether he borrow'd them from *Anaximander* or any other author, which relate to countries and nations that were still unknown: Yet some things are more certain as coming nearer to *Herodotus*' account; for, as to *Onomacritus*' hero's they direct their course along the south shores of the *Pontus*; and the names of these places are well known and true; but when they direct their course to the west and east, then neither do the *Amazons* nor *Tauri* inhabit their own country; and the springs of the *Thermodon*, *Phasis* and *Tanais* are deriv'd from the river *Araxes*, which is tolerable in so great a length of time, and at so great a distance, the courses of rivers admitting of fictitious accounts; but to the north *Onomacritus* confounds every thing, and places here and there at random people whom he ever happen'd to hear mentioned: But his greatest blunder is, that he joins the *palus Mæotis* in one continued channel with the northern sea: There he places the *Pacti*, the *Arctei*, the *Lælii* and the *Scythians*; and he makes the *Argonauts* travel thro' the *Tauri*, the *Hyperborei*, the *Nomades*, the *Caspîi*, the *Riphaei* to the *Hyperborean* ocean, as far as the *Macrobi*, and to the *Cimmerii* living in darkness between the *Riphaean* and *Caspian* mountains, and afterwards to *Ireland*, and through the streights of *Gibraltar* to *Hercules*' pillars; and this, to make the story the more ridiculous, in the space of a few days. This clumsy manner, wherein *Onomacritus* frames his story, discovers his ignorance, as he scarce knew any thing more than the name of the *Scythians* and of some neighbouring nations: We are, therefore, carefully

carefully to guard against quoting this man (who would entertain his readers with things he knows nothing about, and with idle tales) as a good and accurate author on these countries, as some learned men have done before us. Such as after him writ *Argonautics* gave an account of nations visited by the *Argonautæ*, not such as really dwelt there in the most ancient times, but such as they had heard liv'd there in their own days, or at some other time. As to these we are, therefore, to be more upon our guard than those learned men above-mentioned have been, who, by comparing the inconsistencies in *Onomacritus* and the other *Argonautic* writers, have thereby caus'd universal confusion.

Æschylus in his *Prometheus Vincetus* agrees with *Onomacritus*, that the *Scythians* dwelt above the *Maotis*; he also places their country among deserts, and makes it extend to the ocean, with which the *Maotis* may mix: He also knew the *Chalybes*, the *Amazons*, and the streights of the *Maotis*. *Æschylus'* opinion about the situation of the *Scythians*.

That ignorance of the country of the *Scythians* continued till *Darius'* expedition; for, at that time it was, that by means of the *Ionians* and other *Greeks* who were in his army, was discover'd what was unknown till that day. From among them *Scylax Caryandensis* was sent by *Darius* to survey the coast; and his *Periplus* is still extant. He has describ'd the coast of the *Pontus* more accurately than *Onomacritus*, and some other places of those tracts to better purpose than *Herodotus*. *Herodotus* had known, that *Scylax* was sent by *Darius Hystaspes* to survey the coast of *Asia*; but he did not know that he also survey'd the coast of *Europe* and *Scythia*. *Dionysius* of *Halicarnassus* in his first book of *Alexandria* relates, that *Scylax* dedicated to *Darius* his *Periplus* of *Europe* and *Scythia*, as an uncertain author has it in his *Elogium* on *Scylax*, first publish'd by *Hoeschelius*. Whether he survey'd these coasts by *Darius'* orders or of his own head, or whether he only writ down the relations of other sailors, (for, *Caryanda*, his country, was adjoining to *Caria*; and the voyages of the *Carians* are very well known^b) nothing is more certain than that his *Periplus* should be referr'd to this time. I am not ignorant, that Mr. *Dodwell*, for whom I have always had a very great regard, makes this *Scylax* much later than *Herodotus'* days; but he seems to have entirely lost himself in that whole dispute; for, says he, there are some things in *Scylax's Periplus* which refer to later times: I own that it is so; but some of these, according to Mr. *Dodwell* himself, are to be referr'd to the CXI olympiad, others to the CXVI. olympiad, and some again to the CXXXV olympiad, which is an interval of 96 years. On the contrary, you may find in *Scylax* certain marks of greater antiquity; and this *Dodwell* has also acknowledg'd in several instances, and particularly in one, namely, that *Scylax* calls *Tore* an island, which after *Alexander's* expedition to *Persia* was a peninsula; he, therefore, liv'd

^b Lib. 1. cap. 171.

liv'd before that war: Besides, *Scylax* must have writ at a time when the coast of *Afric* and *Asia* was more known than that of *Italy*, *Gaul*, and *Spain*; he, therefore, only has the *Volsi*, the *Campani*, and the *Samnites*, but makes no mention of *Rome*, whose fame had not hitherto reach'd *Greece*: Whence it appears to me as a thing beyond dispute, that the other things in this author, agreeing to other times, were added to him by the transcribers, and afterwards taken into the text, as was the case with many other authors, especially those of this class. After this time the *Athenians* were so eager in knowing these countries, that their great men spent whole days in the forum with such as sail'd from the *Phasis* or *Borysthenes* to learn strange stories from them, as *Aristotle* in *Athenæus* has it^c. But such strange accounts produc'd those wild stories about the *Scythians*, to which *Maussacus* seems not without reason to have referr'd the *Abaris* of *Heracledes*.

Herodotus' manner of collecting his history, and his extent of *Scythia*.

But *Herodotus* was a man of another stamp, who so behav'd among the *Olbitæ* and other inhabitants of *Pontus*, as not entirely to reject their fables, being aware, that sometimes some truth is conceal'd under them; yet he enquir'd with sagacity what, in every relation, seem'd to be the truest. I shall, therefore shew, as we have it from *Herodotus*, in what parts the *Scythians* dwelt about the time of *Darius'* expedition; for, they possess'd the country between the *Borysthenes* and *Tanais*. They had the *Tanais* to the south, as our author says, but there were no *Scythians* on its farther bank, excepting the rebels, or such as were banish'd from the rest of the body, and driven from the banks of the *Tanais* farther to the east. Now *Herodotus* writes, that there is ten days journey from the *Danube* to the *Borysthenes*; and from the *Borysthenes* to the *Palus Meotis* as many. From the east of *Scythia* to the west he reckons 20 days journey, and as many from *Pontus* to the *Melanchlæni* overagainst *Scythia* to the north. He reckons 200 *stadia* to a day, and this (namely as to the *stadia*) causes the greatest difficulty: But I think I have hit on a way, whereby we may come to the truth as near as may be. *Eratosthenes*, as *Strabo* relates, assign'd 700 *stadia* to 1 degree of the equator; but *Ptolemy* from careful observation, as he says, only 500 *stadia*, whom a great many of the ancients follow. *Herodotus'* *stadia* agree with those of *Ptolemy*, as appears plainly, upon comparing *Herodotus'* measures, which I here subjoin with *De L'ile's* very accurate tables, which we have follow'd in settling these tracts of the earth. *Herodotus* says,

Herodotus' measures.

That the <i>Pontus Euxinus</i> , where broadest, is in breadth	3200 <i>stadia</i> .
The mouth of the <i>Pontus</i> , or <i>Bosphorus</i>	4
From the mouth of the <i>Pontus</i> as far as the <i>Propontis</i> is in length	120
That the <i>Propontis</i> is in breadth	500
And in length	1400
	Accord-

According to these numbers, therefore, of *Herodotus*, as to the countries in question, to one degree of longitude there will be reckon'd 347 *stadia*, each of 600 feet, as *Herodotus* expressly requires, or 208200 feet. Now we shall reduce to a *calculus* the dimensions of *Scythia*.

Dimensions of
Scythia.

	Days.	Stadia.	Degr.	Feet.
From the <i>Danube</i> to the <i>Borysthenes</i>	10	2000	5	159000
From the <i>Borysthenes</i> to the <i>Mæotis</i>	10	2000	5	159000
From the east to the west of <i>Scythia</i>	20	4000	11	109800
From the <i>Pontus</i> to the <i>Melanchlæni</i> , or } to the north	20	4000	11	109800

The two first measures of *Herodotus* are not very wide of the truth, if you travel from the *Danube* to the *Borysthenes* along the coast; and this is the reason, that the *Mæotis* is also at the same distance from the *Borysthenes*; for, either way the course is interrupted by the running in of the coast. But in *Scythia*, an open and champaign country, which is neither interrupted by woods nor ridges of mountains, there is a direct course. There is one difficulty, namely, *Herodotus* writes, that from the west to the east is 20 days journey. But *Herodotus* excellently well explains his meaning, when he includes *Scythia* between the *Agathyrsi*, *Neuri*, *Androphagi*, and the *Melanchlæni*: And this we must always carry in our eye to make every thing hang well together. And thus having connected and compar'd every thing well together, I hope it shall be found either that this was the situation of the *Scythians*, or because there can be no such great certainty in these matters, that I have not been very wide of the truth. *Scythia*, therefore, is situated nearly between 45 and 57 degrees of longitude, and between 47 and 55 degrees of latitude; colonies from which crossing the *Borysthenes* possess'd some extent of land as far as *Tiras*.

As to the order of the rivers in *Herodotus*^d it is as follows; from *Scythia* run five rivers, which empty into the *Danube*; the *Porata* (according to *Ammianus Marcellinus*, *Porota*) a large river, coming from the east, retains to this day its ancient name *Prut*, into which run the *Colazinus*, *Cosmannus*, *Zuzur*, *Zur*, *Bassenus*, *Caroccia*, *Caminea*, *Caldarussa*, *Zizia*, *Valemare*, *Valebratuleni*, *Mosna*, *Nirnona*, *Calmazuia*, *Sapusna*, *Strimba*, *Serata* the east and west, *Cigieza*, *Larga* and *Ilana*, as Prince *Cantemir* calls them in his MS. history of *Moldavia*. The *Greeks* afterwards, according to *Herodotus*, chang'd the name *Porata*, so as to be corrupted into *Πορτα*: Whence *Constantinus Porphyrogenetes*^e makes it *Βπορτα*, and at this day *Prut*. The *Tiarantus* of *Herodotus* is the river *Alaut*; for, according to *Herodotus*, there are three large rivers between *Tiarantus* and *Porata*, the same number as at this day between this river and the *Alauta*: Besides, *Ptolemy* thus also places his *Alauta*: But of the three, *Ordissus* is one, which still retains its ancient name; for, it is call'd *Argischa*, and by the *Greeks* after

The *Scythian* rivers, &c. in *Herodotus* settled.

^d Lib. 4. c. 47, 48.

^e De administr. Imperio f. 108. Ed. Band.

after *Herodotus* Ἀρδανόν, as appears from the *Scholia* on *Hesiod*. The *Naparis* of *Herodotus*^f is the *Ialoniza*: The *Ararus*, the *Hierastus* of *Ptolemy* (which Prince *Cantemir* took to be the ancient name of the *Prut*) the Σηπερ of *Constantinus Porphyrogenetes*, from its ancient corrupted name is at this day also call'd *Siretus*, and by some *Moldoua*; for, it is a river proper to *Moldavia*, running from its outmost confines towards *Poland*, and disemboguing, according to Prince *Cantemir*, at two mouths into the *Danube*, and encompass'd on each side with mountains and woods. Next to these rivers offers the *Maris*, which from its source still retains its ancient name, *Marosch* or *Merisch*, till at *Sigeth*, after losing its name, it mixes with the *Tibiscus* or *Teiss*, with which it discharges itself into the *Danube*: But the *Maris* is by *Herodotus* separated from the *Scythian* rivers, nor should it be mention'd by us, did not *Herodotus* place the *Agathyrsi* upon it. The next is the *Tiras*, call'd by the *Turks*, *Turla*, retaining something of its ancient name, and by *Constantinus Porphyrogenetes* and other *Greek* authors call'd *Danastris*; whence at this day it is call'd *Dniester*: It rises from a lake, which separates the *Scythians* from the *Neuri*, I say a lake, upon the authority of *Herodotus*, whatever be its source. Next to the *Tiras* is the *Hypanis*, now the *Bog*. *Rudbeckius* took it to be the *Priepilius*; but I think I have clear'd this up in another place^g. *Hypanis* rises from a lake, which by *Herodotus* is call'd Μήτηρ Ὑπανι, and in *Scythia* is situated to the west, near which places are *wild white horses*. *Dio Chrysostom*^h thus describes the mouth of this river, 'near the sea it forms a large lake, it is slimy and calm in still weather, the river itself is deep and rapid, its banks marshy, cover'd with reeds and trees, so that some of the trees appear also in the lake like masts of ships, and there is plenty of salt there.' Into the *Hypanis*, according to *Herodotus*, a small and bitter river falls, call'd *Amxampes* by the *Scythians* (which he says signifies to the *Greeks* Ἰεγας Ὀβας) which is the boundary of the *Alazones* and *Scythæ Aratores*; but it is 800 *stadia* distant from the sea; for, in a course of four days from the *Amxampes* to the sea, the *Hypanis* is said to run bitter. In another place *Herodotus*ⁱ places the country Εξαμπαίος between the *Borysthenes* and the *Hypanis*; and he says, that from that country the river *Exampes* runs, which before he had call'd *Amxampes*, seeing to this very river, almost at an equal distance, the *Hypanis* and *Tiras* run; a little below the bitter river, the *Tiras* takes a compass round, and the *Hypanis* also diverges, according to *Herodotus*; characters, which induced me to place *Amxampes* where now the small river *Sinauda* is. The *Borysthenes* is the next to the *Hypanis*, call'd by the uncertain author of the *Periplus Ponti Euxini*, *Danapris*, from which it is now call'd *Dniper* by an old *Scythian* word. After *Herodotus* some who yet have ventur'd to write

^f Ed. Heinlii.

^g De Numo Rhodio p. 9.

^h f. 437.

ⁱ f. 157.

write of things at a greater distance back, and of which they had no certain account, trace the source of the *Borysthenes* from the *Montes Alaunici*, as they are call'd; but it is not to be wonder'd at, if the heads of rivers are by ancient geographers placed either in lakes, marshes, or mountains, that they might not seem to be ignorant of any thing: And, indeed, *Matthias Miechovius*, a canon of *Cracow*, has observ'd, that the source of the *Borysthenes* takes its rise in a plain of *Sandomir* and not in mountains, of which there are none in that territory. The *Borysthenes*, according to *Herodotus*, is a river inferior to none but the *Nile*; it glides in a very pure channel, and near its banks are fruitful fields; its mouth is stor'd with plenty of salt and large fishes, which the inhabitants broil and feed upon. The river was known to the *Greeks* from the country *Gerrbus*, which was 14 days sailing distant from the sea. At 10 days journey from the same country dwelt on the *Borysthenes* the *Scythæ Aratores*; at their mouth the *Borysthenes* and *Hypanis* mix'd together into one lake before they disembogu'd into the *Pontus*: The breadth of each mouth was equal, and the lake extended for 200 *stadia*. The promontory, situated in the middle between both rivers, was call'd *Hippoleon*, famous for a temple of *Ceres*: And in that promontory, overagainst which the rivers fell from the lake into the sea, was in *Dio Chrysostom's* time the fort *Alektoros*, so call'd from the consort of a king of the *Sauromatæ*. To the east the *Panticape* running from a certain lake to the north, and passing along the territory of *Hilæa*, fell into the *Borysthenes*. I place it there where at this day the *Samara* is, or a little below this river; for, the *Scythæ Agricolæ*, who were allied to those of the same name, living on the western bank of the *Borysthenes*, dwelt 11 days journey from the *Panticape*, that is, as far as *Gerrbus*: The *Panticape*, therefore, was not far from the sea. *Dionysius Periegetes*, however, and others describe its mouths as not far from the *Pontus*; from whence I think it happen'd, that some, comparing the *Panticape* with the *Hypanis*, said, that below *Olbia*, or the town *Borysthenes*, it mix'd with the waters of the river of the same name^k. Next to *Panticape* the *Hypacris* falling from a lake thorough the middle of the country of the *Scythæ Nomades*, and leaving the *Hylæi* on the right, disembogu'd at the town *Cercinitis* into the *Pontus*: But the river *Gerrbus* even at its source, bordering on the territory of that name, ran in the middle between the *Scythæ Nomades* and *Regii*, till it discharg'd itself into the *Hypacris*. In *Ptolemy* there is nothing but confusion; the *Hypanis* is describ'd some degrees more easterly than the *Borysthenes*, so that one may hence suspect that in *Ptolemy* it should be written *Hypacris*. The river *Cercinitis* is different from that in *Ptolemy*, which discharges itself into the *Sinus Cercinitis* and the *Pontus*, as *Herodotus* says of the *Gerrbus* and *Hypacris*: But the *Gerrbus* is by *Ptolemy* made more easterly, as if it mix'd with the *Palus Mæotis*: And that we may not be so much

surpris'd at this, we are to know, that the numbers of the degrees in *Ptolemy* are corrupted; for, if you examine him rightly, the *Hypacris* is in express terms plac'd to the west of the *Borysthenes*; the *Cercinitis*, therefore, of *Ptolemy*, is the same with what was the *Hypacris* of *Herodotus*: But how it happen'd, that the *Gerrbus* should seem to *Ptolemy* to run into the *Palus Mæotis*, which according to *Herodotus* mix'd with the *Hypacris* and *Pontus*, I shall easily remove that difficulty from a remarkable but corrupted passage in *Pliny*¹; 'the bay, says he, is call'd *Carcinitis*, the river, *Pacyris*; behind, the lake *Buges* falls into the sea by an artificial canal, and *Buges* itself is separated from *Coretus*, a bay of the *Palus Mæotis*, by a rocky ridge; it receives the rivers *Gerrbus* and *Hypanis*, which come from different parts; for, the *Gerrbus* separates the *Basilides* and *Nomades*: The *Hypanis* runs in an artificial canal thro' the *Nomades* and *Hylæi* into *Buges*, and in a natural channel into the *Coretus*.' Where *F. Harduin* has already observ'd, that the *Pacyris* is the *Hypacris* of *Herodotus*; and he has also hinted, that the *Buges* is the *Buxus Λιμνῆ*, the *Byces* of *Valerius Flaccus*, and the *Buces* of *Mela*. But there still remains a difficulty, namely, that he did not advert, that *Coretus* should be read *Cercinitis*, and that from *Herodotus*, whom *Pliny* has follow'd in this place; for, how could the *Gerrbus* discharge itself to the east into the lake *Byces*, and the *Hypacris* from the west into the *Coretus*, or beyond *Byces*; 'and yet two rivers, as *Mela* speaks, disembogue at one mouth from different sources, and in different channels.' And fall into the *Cercinitis*, as *Pliny* plainly hints. The case is, therefore, this, the *Hypacris* and the *Gerrbus* disembogu'd at one mouth into the *Cercinitis* and the *Pontus*; yet by an artificial canal reaching to *Byces* and the *Palus Mæotis*, by which it discharg'd itself at another artificial mouth: This is that famous canal which *Herodotus* relates to have been made by the slaves of the *Scythians*. *Constantinus Porphyrogenetes*^m says, that in his time that canal was fill'd up with earth, and overrun with wood. The *Tanais*, the last *Scythian* river, at this day the *Tan* and the *Don*, ran, according to *Herodotus*, from a great lake, now call'd *Juan*, and fell into the *Mæotis*; but it is very obscure what rivers *Herodotus* means, when he says, that the *Lycus*, the *Oarus*, and the *Syrgis* fall into the *Mæotis*. *Ptolemy* also has the *Lycus* to the west three degrees nearer than the *Tanais*: It is, therefore, possibly the river *Silik*, which has retain'd something of its ancient name, unless that be its ancient name, of which the *Greeks*, according to their custom, made *Lycus*, that it might sound the less barbarous: But the *Oarus*, if it is the *Agarus* of *Ptolemy*, confounds *Herodotus*' account; for, it should be plac'd to the west of the *Lycus*; now, indeed, it is uncertain where it must be plac'd: Yet it is certain, that *Herodotus* places it between the *Lycus* and the *Tanais*. The *Syrgis*, in another place call'd

¹ Lib. 4. c. 12. ^m l. c. f. 113.

Tyrus by *Herodotus*ⁿ, runs into the *Tanais*; it must, therefore, be what is call'd the *Lesser Tanais* and the *Sevierky*, which is a trace of its ancient name. *Herodotus*^o says, that these rivers run from the *Thyssagetæ*, not from the country of the *Thyssagetæ*, but from a neighbouring country; for, a little after that, he places the *Oarus* in a desert, which was below the *Thyssagetæ*, or to the south of them: The remaining river is the *Araxes*, or the *Volga*, as I have already shewn*. The *Pontus Euxinus* and the *Caspian Sea* are too well known to say any thing of them. *Aristeas Proconesius* calls the *Pontus* the *South Sea* with respect to the *Scythians*, but *Herodotus* calls it the *North Sea* with respect to *Greece*. What shews the great accuracy and truth of *Herodotus* is, that he makes the *Caspian Sea* to be longer in proportion to its breadth, as was a few years ago discover'd by the *Russians*, and not square, as some moderns would have it. To the west of the *Caspian Sea* he places the *Caucasus*, but to the east a very spacious plain, the largest part of which the *Massagetæ* possess: This plain is very famous in *Arabian* and *Persian* authors by the name of *Kaphgjak* and *Dascht*, which signifies a plain. In fine, he describes, yet without giving them any name, the mountains farther to the east; for, the *Volga* to the west is included within a higher bank: Whence that country is at this day call'd *Nagorna*, that is, *mountainous*. Yet there are no hills there, but a plain with a higher bank; but to the east there is a large plain, which tract is, therefore, call'd *Lugavoia*, that is, *champaign*; these mountains, therefore, mention'd by *Herodotus*, are no other than what at this day are call'd *Vergaturii*, of old *Riphei*.

After having thus settled in their proper situation the seas, rivers, mountains, and plains, which no tract of time nor reverses of fortune could alter, I shall use these aids to describe the nations in their proper countries. *Timonax*^p in his first book *de Scythia* writes, that there are 50 different nations of them: But as it is uncertain at what time *Timonax* writ this, and whether we are to understand him of the people of his own time, or whether he borrow'd it from the writers of former times, I lay no stress upon his testimony: I shall, therefore, follow, as it were, the order of nature, and determine the positions of nations from *Herodotus*, and establish my opinion by proper arguments, where it shall seem necessary. Now from the *Danube*, on the coast of the *Pontus*, we meet with the *Tiritæ* near the mouth of the river *Tiras*, where now is *Belgorod* and the *Butziacks*. The *Scythæ Aratores* possess'd the inland country from the river *Tiarantus* as far as the *Tiras*, which *Herodotus* has, therefore, reckon'd among the rivers of *Scythia*: They, therefore, possess'd *Walachia*, *Moldavia*, and a small tract of *Transylvania*. The *Agathyrsæ*, a nation even of *Scythian*

And thereby the nations themselves settled.

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ⁿ *Lib. 6. c. 123.* ^o *Ibid.*

* *Vide ACTA GERMANICA, &c. of the origin and ancient seat of the Scythians, Vol. I. p. 163, seq. Ed. Anno 1742.*

^p *Ap. Schol. Apollonii Rhodii, Lib. 4. v. 321.*

original, were more westerly beyond the river *Maris*, that is, in the western *Transylvania*. After passing the *Tiras*, on the coast were the *Callipidæ* and above these the *Alazones*, both of them between the *Tiras* and *Hypanis*. The situation of the *Alazones* is more certainly known than that of the *Callipidæ*; for, the source of the *Hypanis*, according to *Herodotus*, separates the *Alazones* from the *Scythians*. To the east are the boundaries of the *Alazones*, and overagainst them the *Hamaxampes*; and now there is left a country as far as the sea for the *Callipidæ* near the *Olbitæ*, as *Dionysius of Halicarnassus* has it. The *Olbitæ* dwelt above the *Hypanis* and the *Alazones* upon it, both of them to the west of the town *Olbia*; yet the *Alazones* are more northerly than the *Callipidæ*: The *Alazones*, therefore, were in the south part of the Palatinate of *Podolia* at *Caminieck*, and in the territory of *Braclau*, where it extends between the *Bog* and the *Niefter*: But the *Callipidæ* in the eastern tract of *Braclau* and in the territory of *Ozacow*. Between the *Hypanis* and *Borysthenes* were the *Olbitæ*, a Greek colony, where now are the *Dzike Pole*, the desert plains, and some part of the territory of *Ozacow*. The *Scythæ Aratores*, who were allied with those *Scythians* (whom I placed above in *Walachia* and *Moldavia*) both by blood and the similitude of their manners, possess'd the farther parts. The union of the two bodies of the *Aratores* was, as it were, broke to the north at the source of the *Tiras* by the *Neuri* and by the *Alazones*, by means of the *Hypanis* itself, as far as the *Hamaxampes*. The *Gerrhus*, a country to the east of the *Borysthenes*, is distant from the sea 14 days journey; from that country for 10 days journey the *Scythæ Agricolæ* inhabited as far as the *Olbitæ*: They, therefore, possess'd the Palatinate of *Braclau*, and all that extent of country from the source of the *Bog*, as far as *Kiow*, between the *Borysthenes* and *Hypanis*, only that at the conflux of the two rivers the *Olbitæ* inhabited. From the source of the *Tiras* the *Neuri* dwelt above the *Scythæ Aratores*, as far as the *Borysthenes* in the eastern part of the Palatinate of *Lemberg*, *Belczu*, and *Volhynia*; which country was from them call'd *Neuris*. The *Geloni* and *Budini* are more westerly^a, where now is the Palatinate of *Chelm* and *Briejcia*. Anciently the *Neuri* inhabited to the east of the *Borysthenes* above the *Scythæ Agricolæ*, and were call'd *Νευροι* or *Νευριται* by Greek writers^r: But one generation before *Darius'* expedition^s, because such a great number of serpents was produced in their country, and came from the north out of the desert, that they could no longer continue in that country, they went over to the *Budini*, to whose neighbourhood they were receiv'd. In the year 4199 of the *Julian* period *Darius* recover'd *Babylon*, and after that, he enter'd upon the *Scythian* war, as *Herodotus* testifies in the beginning of his *Melpomene*. *Herodotus*^t seems to describe

^a Herodot. *Lib.* 4. c. 51. ^r *Ib.* c. 105. ^s Eustathius ad *Dionysii* v. 310. ^t For, in *Lib.* 1. c. 7. he reckons 505 years to 22 generations of men not compleat: And *Lib.* 2. c. 42. he says, that 3 generations make 100 years. one.

one generation from 23 to 24 and 30 years. The *Neuri*, therefore, pass'd the *Borysthenes* about the year 4176 or 4165 of the *Julian* period: Yet *Herodotus* adds nothing, from which it may sufficiently appear where the *Neuri* inhabited before, or where the *Geloni* and *Budini* dwelt. I shall relate from what reasons I was induced to place them in their proper seats: The *Budini*, a populous nation, were of *Scythian* extraction, but being driven out anciently from the rest of their own body, they remov'd from *Scythia* to the west of the *Borysthenes*; for, from this arose the story among the *Greeks* of the two brothers, *Gelonus* and *Agathyrfus*; being banish'd from *Scythia*, which is related by *Herodotus*. But as the *Agathyrsi* remov'd to the west, so did also the *Budini*; but the *Geloni*, a *Greek* colony, according to *Herodotus*, being mixt with the *Budini*, partly retain'd something of the *Greek* manners, and partly adopted those of the *Scythians*: From this it happen'd; that the *Budini* went also by the name of *Geloni*: But this in *Herodotus*' judgment is erroneous, as the *Geloni* were of a different original and different in their manners, and us'd a mixt language of *Greek* and *Scythian*, whereas the *Budini* only us'd the *Scythian*; and as the *Geloni* follow'd agriculture and gardening, and dwelt in towns, but the *Budini* only applied themselves to the care of their herds and flocks: Yet from this confusion was fram'd the story of *Gelonus*, as the father of the *Scythians*, tho' he had no relation to the *Budini*, much less to the *Scythians*. The town *Gelenus*, situated among the *Budini*, gave to these *Geloni* their original and surname; it was encompass'd with a wall, each of whose sides measur'd 30 *stadia*; all their houses were of brick, the temples and altars were those of the *Grecian* Gods, but their statutes were of wood. *Stephanus Byzantius* places the town among the *Sarmatæ*. This migration of the *Budini* and *Neuri* is a memorable period in the history of the north; for, as we learn from the northern mythology, from that time *Odin* the first and the *Fenni*, or the *Neuri* and the *Budini* went to the *sinus Botnicus* and to *Scandinavia* itself: The *Neuri*, therefore, dwelt before on the river *Desna*, but afterwards in the lowest part of *Lithuania* and in a certain part of *Volhynia*; but the *Budini* and *Geloni* on the borders of *Bressici*. Above the *Neuri* and *Budini* *Herodotus* places a desert to the north, adding, *so far as I know*; for, as *Plutarch* has it in his *Theseus*, such, as describ'd the situations of ancient countries, if they did not know them, feign'd that the country was all sands and parch'd up, marshy lakes, ridges of mountains and a frozen sea, lest they should leave any void spaces in their maps; of which they should seem to know nothing; yet the *Venedi* and the islands *Electrides* in the *Baltic* sea, and the *Eridanus*, which is now *Duna* near *Riga*, were names known to *Herodotus*, as we have mention'd elsewhere^u.

Beyond

^u Vid. *Dissertationem de Numo Rhodio*.

Beyond the *Borysthenes* on the coast is the country *Hylæa*, included between the *Panticape* and the *Hypacris*, the only woody country of all *Scythia*; and at this day it is the *Lesser Tartary*. Above this tract extend to the east along *Panticape* the *Scythæ Agricolæ* for three days journey and 11 days up the *Borysthenes*; and therefore as far as the river, now call'd *Desna*, in the tracts of the eastern *Ukraine*; there lay the country *Gerrhus* and the burying place of the *Scythian* kings: Above it was a large defart, and beyond it the *Androphagi*, a peculiar nation and by no means *Scythian*, in the tracts of the territory of *Smolensko* and *Vitepsko*, afterwards a defart and uncultivated place, *as far as we know*, says *Herodotus*. After passing the *Panticape*, the *Scythæ Nomades* incline to the north along the river *Gerrhus*; and part of them is situated to the west of the *Hypacris*. In the *Chersonesus* the *Tauri* inhabited a large tract to the west; for, the *Scythæ Regii*, call'd *Apisoι*, or *Optumi*, possess'd the western part of the *Peninsula*, who extended from this country to the *Gerrhus* and the *Sinus Cercinitis*, and beyond the canal made from the *Gerrhus* to the *Byces* northwards to the lake, from which the *Tanais* arises, and to the east as far as the mouth of the *Tanais*, which country is now possess'd by the *Crim Tartars*, *Nogaians* and the *Cossacks*. Above the *Scythæ Regii* are the *Melanchlæni*, a nation by no means *Scythian*, in the territory of *Moscow*, and in the neighbouring tract to the east. What extended farther to the north was by *Herodotus* fill'd with lakes, marshes and defarts. *Plutarch*^w had been inform'd by those who travell'd *Scythia* and *Thrace*, that there were frequent lakes and marshes in those parts, to which *Possidonius* imagin'd was owing the extremity of cold in these countries. Beyond the lakes and defarts they related, that the air was *so full of feathers*, as to blind travellers; and this *Herodotus* explains of the great quantity of snow that falls there: Yet posterity gave way to this idle story of the *Scythians*, by giving the appellation of *Pterophoron* to this country, *from the continual fall of snow, resembling feathers*, as *Pliny*^x says. *Herodotus* calls the country on the *Mæctis*, thro' which the *Lycus* and *Oarus* run, the *Mæotis*. Beyond the *Tanais* in the inmost bay of the *Mæotis* dwelt the *Λαζιοι*, or rather *Λαζιοι Sauromatæ*: Its inmost bay lies where the *Mæctis* runs very far into the coast of *Asia*, where it receives the *Tanais*. These *Lazii Sauromatæ* dwelt 15 days journey towards the north. The reason why I cannot compare these days to *stadia* is, that as all that country is mountainous, several *stadia* and those of an uncertain number make up a degree; as when *Herodotus* says, that it is 30 days journey from the *Mæotis* to the *Phasis*, and that is a distance of four degrees, thro' mountains and by-ways: Whereas in a plain 30 days according to *Herodotus* made 12 degrees

^w T. 2. l. 959.^x Lib. IV. c. 12.

degrees. I have, therefore, placed the *Lazii* in those parts where they dwelt long after *Herodotus*' days. *Herodotus*^y was here mistaken, when he thought, that the *Λαξιοι* were so call'd from *Λαξίς*, a *chusing by lots*; for, alluding to this etymon, he says, that the *Budini* obtain'd the second lot above the *Lazii* more to the north. *Herodotus* writes, that the *Amazons* came from the *Sarmatæ* near the *Danube*, and the coast of the *Pontus* and *Mæotis* to the north, and made a descent upon the *Cremni*, and in the manner of robbers, over-run that tract, which is between the *Cremni* and the mouth of the *Tanais*, that they settled to the north, and being afterwards blended with the *Scythians*, took a resolution of passing the *Tanais*^z. Here they settled between the *Lazii* and *Budini* to the south of both; their language was *Sarmatian*; they with difficulty learn'd the *Scythian* language (so that *Herodotus* says that they spoke a corrupt language) from the *Budini*, whose embraces they courted. Above the *Budini* to the north is a desert extending for seven days journey, to wit, from the river *Syrgis* and the sources of the *Lycus* and *Oarus*: Higher than that desert dwelt the *Thyssagetæ*, the *Thyrsgagetæ* according to *Valerius Flaccus*, a numerous people, and not of *Scythian* original; and with them the *Iyræ* dwelt in the same parts towards the south-east. The *Scythæ Rebelles* or *Exules* were more to the east, who were banish'd by the *Scythæ Regii*: All their country is *champaign*. From the *Scythæ Exules* the country began to be rugged and stony, which at length rose into high mountains. Now there are no mountains in these countries except the *Riphæi* beyond the *Volga*, now call'd the *Vergaturii*: And these shall be our direction in arranging the situation of these nations: And indeed, the entire western bank of the *Volga* is call'd *Nagorna* or *mountainous*; but such as have sail'd on that river have observ'd no mountains, only that the bank was higher, since the eastern bank is marshy and one large plain: There are, therefore, no other mountains but the *Riphæi*; and at the bottom of these mountains *Herodotus* places the *Argippæi*, call'd also *Sacri* and *Calvi*, from their *baldness*, which both the men and women have always had from their birth. These *Calvi* (who, according to *Herodotus*, had flat noses and long beards) were great masters of equity and the laws: Their religion, and not their arms, of which last they had none, were their security against their neighbours. The *Scythians* and *Greek* merchants from the *Borysthenes* and from all parts of *Pontus* maintain'd a commerce with them; and the *Scythians* gave out, that this correspondence was kept up between them by means of seven interpreters and as many languages. Many lesser nations, therefore, of different originals, which are now unknown, must have lain between them. No one has penetrated beyond the *Argippæi* to the north, on account of the high mountains, at the foot of which the *Argippæi* dwelt. The *Argippæi* related

^y Lib. IV. c. 21.

^z Lib. IV. c. 110.

related, that the *Ægipodes* dwelt among those mountains, and that beyond these dwelt such as sleep for six months, which points at the outmost parts of the north. To the east of the *Argippæi* dwelt the *Arimaspi*; yet so that the *Ægipodes* and *Gryphes*, the guardians of gold, were also to the north of these. The *Hyperborei* are placed above them all in uncertain tracts under the pole; and all these nations above the *Argippæi* and *Iffedones* were not known either to the *Scythians* or *Greek* merchants. The *Argippæi* and *Iffedones* were the only people who mention'd any thing of them. Now the *Massagetæ* possess'd to the east and beyond the *Araxes* large tracts of land on the *Caspian* sea over-against the *Iffedones*; but the *Iffedones* had the *Argippæi* for their neighbours to the west, the *Arimaspi* to the north, the *Massagetæ* to the south and probably also to the east, and they reach'd to the *Caspian* sea.

Thus, therefore, have we (taking *Herodotus* for our guide) describ'd the situation of these nations, according as the nature of the tracts and probable indications seem'd to bear. I shall briefly show, how widely *Olaus Rudbeckius* differs from us, and how he places at random those people all over the north; 'the *Callipidæ*, says he, are on the *Borysthenes*; 'the *Halizones*, where now stands *Halizum*; the *Scythæ Aratores* in 'Poland and *Livonia*; the *Neuri* on the eastern bank of the *Weissel*, 'as far as *Narva*: And in fine, the *Scythæ Agricolæ*, who were to the 'east of the *Borysthenes*, are in the territory of *Moscow*. The *Scythæ Regii* are the *Crim Tartars*. The *Melancklæni* are those of *Moscow* as 'far as the *Ladoga* and *Onega*. The *Budini* are on the *Baltic* sea. The 'Thyssagetæ are in *Carelia* and *Sauolaxia*: The *Iyræ* are in *Russia* at 'Jyrgowitz: The *Scythæ Calvi* are the *Laplanders*: The *Sacri*, the 'Uplanders: The *Argippæi* are the *Swedes*, so call'd from a *Swedish* term 'Arkippar, which signifies to fight with darts, with whom the *Scythæ* 'maintain'd a correspondence by means of seven languages, as the *Polish*, 'Russian, *Lithuanian*, *Esthonian*, *Finnic* and *Lapponic*: And in fine, 'the *Iffedones* are by him placed in *Esthen*.' I shall not spend time in confuting these things, seeing any one may easily understand from what we have said, that he has gone in too vague and loose a manner from the *Borysthenes* to *Scandinavia*, without regarding the situation of rivers, mountains or marshes; and that he has scatter'd up and down at random the *Scythians* of *Herodotus*.

Nicolaus Witsen in the first edition of his *Northern and Eastern Tartary*^a has in the first part treated of the ancient inhabitants of these countries, and quoted *Herodotus*, but he has no where explain'd him; but in the second edition^b he has entirely omitted that first part. To conclude, that no one may be surpris'd, that we have placed the *Eridanus* of *Herodotus* and the *Venedi* in these parts, we have given the reason in our differ-

^a f. 107. Amst. 1692.

^b Amst. 1705.

dissertation de Numo Rhodio; and we shall treat of it in another place, when we shall have an opportunity of explaining several other things, which we have here omitted.

An Account of the great Fog in October 1717, with Reflections thereon. From the Breslaw Collection, October 1717. Class IV. Art. I. p. 206.

Translated from the HIGH-DUTCH.

AS in this and in the beginning of the ensuing month there fell an extraordinary great fog for 12 days together; so it seems to be worth the while to subjoin here the particular observations we made on this remarkable *phenomenon*; for, after the surface of the earth had been pretty well soaked by a great deal of rain, till *October* 20. and a continued southerly warmth ensued thereon; there was at length observ'd from *October* 22, and especially as the wind began to blow from the east, early every day till noon, and afterwards again in the evening, an extraordinary thick fog; as to which, we think proper to give a particular account of what we observ'd abroad in the open fields on *October* 24, and 25. This fog, it is true, was observable very early in the morning; but it was moderately thick and expanded itself rather somewhat upwards: Whence the sun might be seen about six and seven to shine thro' it without emitting any rays, and resembling a round disk; and like the moon, suffer'd itself to be view'd, without either dazling or causing any pain, in regard the rays were damp'd and weaken'd below by the fog: But as the fog had a manifest motion and different degrees of thickness, so at one time it uncover'd the sun's disk, and again entirely cover'd it. About 9 o'clock it fell very thick to the earth; and it was so dark, that not the least part of the sun's body could be seen, but even persons, trees, and houses, at a few paces distance, were no longer distinguishable. The moistness of this fog was so sensible, that in falling it resembled the finest mizling rain, tho' on account of its subtilty it for a long time, and almost unobserved, fell to the earth. Every thing was so moisten'd thereby, that thick drops were observable on them, and especially on the hair. Along with this was felt a sensibly moist cold, and the air began to move a little. This sensible cold produced no strong wind, especially where the fog was higher and intercepted the rays of the sun by its thickness. However, it was not equally thick, even where it lay low; and in several places one could see a little way off, tho' in adjoining places on the same level, scarce 10 paces off: One could better see directly upwards thro' the fog, and view the azure sky, tho' indistinctly, than directly forwards and horizontally: So that it is manifest, that the height of this fog was not considerable, but

The history of this fog.

that it fell low to the earth. Nay, towards 8 o'clock, before the fog fell lower and in greater plenty on the surface of the earth, the sun as he mounted up, was observ'd to drive it downwards before him towards the west and north-west, as if a thick vapour came down obliquely and slowly towards the latter point, in the same form as we usually observe dark clouds that are equally expanded: And this motion of the fog was plainly discernible; and now the earth and the trees were so wet, that the latter dropp'd plentifully, in the same manner as in a shower of rain. But as all the fields and bushes (but not the trees) were cover'd with fine and very close wrought cob-webs; so this moistening fog stood very thick in small round spherules upon their close threads, yet always apart, without running into one another, tho' as soon as you touch'd them they came together, and caused a moistening. By this equal expansion of the threads, the fields appear'd entirely white, as if they were cover'd all over with rime or snow, as *Menzelius*^a had also observ'd; yet with this difference, that the trees and their boughs appear'd equally moist without this whiteness. This fog seem'd also in some measure to stink, like a strong damp that falls plentifully on the breast and affects the freedom of respiration, and like what happens from the steam of wort and new beer in winter. About 10 o'clock and towards 11 the sun appear'd more and more, and the air became clearer; yet round about, especially towards the west, the fog was still observ'd in the atmosphere like vaporous pieces of clouds; but afterwards it entirely disappear'd, and the air became perfectly clear and warm: Upon which at noon the fields and shrubs soon began to dry again. Now this fog increas'd from day to day; and as at first it only appear'd early in the morning till 6, 7 or 8 o'clock, but afterwards till towards 11, so a little after it again appear'd towards the west; so that at last on the 26th and the following days the air was no longer clear with us, but continued constantly overcast.

Reflections
thereon.

This fog in its peculiar nature was nothing other than 1. a pure moisture, which took its rise from our earth alone, and in its subtile particles mounted up into the air, till at length it was perfectly fit to rise to the height of our atmosphere. 2. A real cloud on the earth, as it had the properties thereof in all its principal *phenomena*; in regard it had partly at a distance and horizontally, and partly afterwards obliquely, the appearance of a cloud; and plainly show'd a progressive motion aggregately, had its different figures, was thicker in some places than in others; and at last form'd real clouds aloft in the air, and also produced the effects of a real cloud, in regard it moisten'd and put the air into motion. 3. This fog, even where it lay low, actually mov'd the air, yet gently, and produced a sensible, cold, moist and gentle wind, which also became stronger, the higher the fog stood. 4. These nebulous vapours are, on account of their subtility

^a Miscel. Nat. Cur. Dec. II. An. V. p. 276.

subtlety perfectly fit to mount aloft into the air, and form an actual cloud, especially when they cannot be dispers'd with sufficient force by the sun; and when the air is warmer, and receives this fog in greater plenty; which probably will happen still the more, if the air come to it from the moist westerly quarter: Yet these separate vapours, if they stand long below, and have no strong progressive motion, may from their mild nature easily come together, become heavier, fall down to the earth, and cause a sensible moistness; yet so that a great part of them is also dissipated and rarefied by the warmth of the sun. 5. Now this falling moisture form'd pure round globules of different sizes, namely, as the particles being subtilely combin'd, fell slowly in form of drops upon pure, subtile and separate threads of cob-webs, by which means they could not touch each other in all their parts, and so run together, but might be fitly collected into such round globules, which was also so much the more promoted by the cool of the morning. 6. But that these foggy and cloudy vapours did not mount together into the air, appears to be owing to this, namely, as the heat of the sun in the day-time draws up a deal of moisture, which in time is easily dissipated, and which in the following night by a continued *impetus* upwards and in an open country is always rais'd still higher, so at last by the additional cool of the morning; and especially on a cold easterly wind ensuing, this moisture is forced downwards, and not rais'd aloft, dissipated and dispers'd: Whence 7. it also fell down, not in form of large but very subtile drops, as they had not a great way to fall, whereby they might become larger in their passage. 8. But that in one day there fell a greater or less fog than in another, as the wind blew constantly from one quarter, appears to be owing to its own progressive motion, and even to that of the wind, as possibly the fog was thicker in one place or district than in another, or as it divided itself, or fell down on hills and eminencies; and consequently there was on one day a greater or less quantity, density and collection thereof, than on another.

A new Method of determining the Maxima and Minima. By D. T. From the Acta Eruditorum Lips. An. 1683. p. 122.

Translated from the LATIN.

AS some of my friends, upon seeing my method of tangents*, publish'd in the *Acta Erudit.* for the month of *December* p. 391. *seq.* Anno 1682. have greatly desir'd to know, by what method I might hence determine the *maxima* and *minima*, and whether this might not probably be done by the same method; so I have resolv'd to communicate some things here in order to satisfy their desire.

E e 2

We

**Vide ACTA GERMANICA, &c. Vol. I. p. 182. seq. An. 1742.*

The determina-
tion of the *maxi-*
ma and *minima*
what? and how
found.
Fig. 7. Plate IV.

We are, therefore, to observe in the first place, that the determination of the *maxima* and *minima* is nothing other than the determination of a special case about the tangents of curves; and to understand this the more easily, I shall illustrate it by an example. Let any indeterminate quantity BC be $=x$, which is to determine some *maximum*; let a denote some given line BH , and let the *maximum* to be determin'd be $aa x^3 - 2ax^4 + x^5$. Let this *maximum* be represented by the line FG , which put $=y$; $aa x^3 - 2ax^4 + x^5$, will therefore be $=y^5$, which equation expresses the nature of any curve by means of two indeterminate quantities: But now to find this *maximum*; nothing other is required than that the greatest ordinate of this curve $BDFH$ be determin'd; but as this ordinate is the line FG , where the line EF , parallel to the axis BH , is the tangent of this curve, there is nothing other necessary than to find the tangent of this curve $BDFH$ in any point generally, and then all the special cases will be likewise determined, and consequently this case too, where the line EF , or the tangent, is parallel to the axis; in the present case therefore, let AB be $=t$; According to the rule I have given for tangents it will be $t = \frac{2 a a x^3 - 2 a x^4}{3 a a x^2 - 8 a x^3 + 5 x^4}$.

We are to observe in the second place, as it is very evident, that if the tangent EF be parallel to the axis, the denominator of this fraction is $=0$: Whence we shall have $3aa - 8ax + 5xx = 0$, an equation, by means of which the quantity x , and consequently the *maximum*, is determined.

We are to remark in the third place, that in order to determine the same quantity BG , if any *maximum* be given, yet still another equation may always be found by seeking the tangent on the other side of this curve: But as thus two equations may be had including the same unknown quantity, it will be no difficulty for the skillful in these matters to determine what is sought: Thus putting $LH = z$, the *maximum* will be $a^3 z z - 3 a a z^3 + 3 a z^4 - z^5 = y^5$. And hence according to my rule of tangents HM will be $= \frac{3 a^3 z z - 6 a a z^3 + 3 a z^4}{2 a^3 z - 9 a a z^2 + 12 a z^3 - 5 z^4}$: Whence now, according to the second remark, the denominator of this fraction $2 a^3 - 9 a z z + 12 a z^3 - 5 z^4 = 0$; in which equation, if instead of z you substitute $a - x$, which is equal thereto, you will have $-3 a x x + 5 x^3$, or $x = \frac{3a}{5}$, the second equation, by means of which the length BG is found.

And thus I have disclos'd a principle, from which is deriv'd as expeditious a method of determining the *maxima* and *minima*, as I have hitherto seen; and it is as follows.

Let BH any given quantity be $=a$, in respect of which any *maximum* or *minimum* is sought; put $BG = x$, and $GH = z$: Now 1. it will be $z = a - x$. 2. Let the *maximum* be form'd by means of the quantity z , so that x do not enter into this expression; and let, for, instance, that *maxi-*

minu-

num be $a^3z^5 - 3aaaz^6 + 3az^7 - z^8$, in which quantity let 2 be prefix'd to the term where z has 2 dimensions, 3, where 3, but 4, where 4, &c. and thus let the exponent of the power of z be always prefix'd to the same term; but let the whole aggregate thus produced be $= 0$: It will therefore be in the present example $5a^3z^5 - 18aaaz^6 + 21az^7 - 8z^8 = 0$, or $3a^3 - 18aaaz + 21az^2 - 8z^3 = 0$. 3. In this last equation let $z = a - x$ be restor'd; and a very simple equation will be found for the quantity x , which determines the requir'd *maximum* or *minimum*, as in the present instance, if in the equation, viz. $3a^3 - 18aaaz + 21az^2 - 8z^3 = 0$, $z = a - x$ be restor'd, x will be found $= \frac{3a}{8}$, by means of which the *maximum* requir'd is determin'd.

The Dissection of a Mole. By Guntherus Christophorus Schelhamerus. From the *Miscellanea Naturæ Curiosorum*, An. I. Dec. II. Obs. CXXX. p. 323.

Translated from the LATIN.

1. **T**HE skin of this animal is very hard and entirely sinewy, so as to require the sharpest knife to cut it thro'; which, besides the sinewy substance of the skin, seems to be owing to this, namely, that as this animal is of a colder constitution, and perpetually lives under ground in cold places, its body perspires but little; consequently, the pores of its skin are, probably, by far smaller than those of larger animals; and nature must have provided, lest the cold should strike too readily thro' these pores and affect the *viscera*; on which account also we observe its hair to be very fine, and therefore softer than any silk, in order to ward off the cold: And that it is so fine is doubtless owing to the small pores thro' which the hairs must pass; for, I observe in such animals as have stronger hairs like bristles about their mouth, as in a cat and a hare, that the pores in these parts are far larger, and plainly distinguishable, but smaller in other parts: Besides, in a hare (to mention this by the bye) at the origin of these hairs I always find a follicle full of a white liquor; this follicle is pretty large, such as is sometimes observ'd even in human hair; and in venereal patients these hairs seem'd to me to be more turgid: But whether this be always the case I cannot aver. Besides, which is equally uncommon, there is this to be observ'd about the skin of a mole, viz.

Description of the skin of a mole.

2. The *panniculus carnosus* so firmly adheres to it, that it seems to grow thereto; for, it cannot be separated from it but by scraping: And besides its corrugating the skin, it is greatly adapted to keep out the cold; for, this fleshy substance, as is usual in the smaller animals, is even far more dense and compact than in the larger animals, as its fibres are smaller and more tendinous.

Of the panniculus carnosus.

3. Next:

Of a peculiar
membrane cover-
ing the *abdomen*,
&c.

3. Next to this pannicle offer'd to view a very thin and pellucid membrane, covering the whole *abdomen* together with the *thorax*, and which could be entirely separated therefrom without tearing; and

Of the muscles.

4. Under this lay the muscles, so that probably it may be call'd the common membrane of the muscles; but for what end it is superadded is not so easy to determine; for, the parts above-mention'd might suffice to ward off the cold: It seems to have been the intention of nature, that the skin should be entirely separate from the muscles, that it might be the more moveable; and among other reasons for this, namely, that its feet, which lie almost conceal'd under the skin, might move the quicker; for, in other quadrupeds the skin is seen to adhere looser about their feet, especially, about the upper back parts: But in this shorter animal almost the whole space between the skin is requisite for their motion, as shall appear anon.

5. The muscles of the lower belly were in all two, consisting of longitudinal fibres, like those of the *recti* in men, but broader, and at length degenerating into a membranous substance, at the place, where they very firmly adher'd to the *peritonæum*. Here I would willingly learn from others, who hold that larger animals are furnish'd with oblique muscles, either for respiration, or the discharge of the excrements, (which no one will deny to be necessary in this animal) why these are wanting in this subject? However these longitudinal muscles seem at the same time to do the office of the transverse muscles, which are really and solely design'd for the discharge of the *fæces*: But here the case is quite different from what it is in man, who being furnish'd with a shorter belly, and squatting down to do this work of nature, requir'd its contraction in breadth, or rather depth; but this animal, while it discharges the excrements, contracts its longer belly towards the breast, whereby it may become shorter, and the diaphragm be impell'd higher, which is common to it with dogs, and many other quadrupeds; but that the *musculi recti* are given it for this end appears from their fibres, as is plain to any one, who is not a stranger in these matters: But to come to the *viscera* themselves, I observ'd in the lower belly

Of the guts.

6. That the guts, cover'd by the *omentum* (which last is wanting in several animals) are not divided into thinner and thicker ones; but are of one thickness throughout, only that the extremity of the *rectum* is wider; but all of them are furnish'd from their beginning to their end with *cellulae* for retarding the chyle, as is the case even in a human subject, where the thinner guts are not without such letts, a thing the generality of anatomists are ignorant of. I am sorry I did not find in my observations what sort of excrements was contain'd in them; for, I suspect that all animals destitute of the thick guts discharge liquid excrements.

7. The

7. The ventricle possess'd the left side, and under it lay the spleen: But the liver did not fill the right side only, but all the upper part of the belly: And I find this always to hold, that it may give way to the ventricle, nor can it otherwise happen, but that it must be forced to the left side by a larger liver; and this also happens sometimes in a man, but not always: But when the ventricle is full, it must necessarily be extended towards the left, if the liver does not give way; a thing to be remark'd by physicians. All birds have a larger liver, probably to compensate the want of a spleen, lest the blood should not be sufficiently comminuted; a thing I also think worthy of remark. The figure of the ventricle was almost the same as in a squirrel and other animals. In the right orifice of the ventricle, or in the *pylorus*, I observ'd a constriction, as if it was tied round with a thread: The insertion of the *oesophagus*, which was in the middle of the ventricle, seems to have been done for this reason, because it was not proper, that either the *oesophagus* should recede from the *vertebrae* of the back, or that the ventricle should be placed in the middle; and therefore, one part of it was to recede to the left; and consequently, this insertion was the most commodious. The stomach was internally all over rugous, and it contain'd a substance, which appear'd to be earth-worms; for, on these and other worms under ground does this animal live; and for this end, that both when he digs the earth and when he raises and throws it up with his snout, he may thus hunt the worms the more carefully, and catch them when forc'd out of their lurking holes; which he does more especially morning and evening, as he is then urged by hunger, but always after rain; because then he discovers them more easily by the scent, and the earth is looser, so that it may be easily turn'd up.

8. The gall contain'd in the gall-bladder had a manifest sweetness with some degree of bitterness; a thing, indeed, which I have found in all animals, and every one who tast'd of it own'd it was so, but which has not been commonly adverted to.

9. Under the intestines I observ'd in the mesentery a glandulous body of a remarkable bulk; so as to resemble one of the thick guts, which I take to consist of lacteal glandules collected here together; for, it was of the conglomerate kind.

10. To both the kidneys there were also adjoining a very white gland, which I could not then examine more accurately: But it deserves remark, that the kidneys themselves have the appearance of a threefold substance; for, externally there appear'd a ruddy border, resembling the spleen in colour: The second substance run from this part into the *pelvis* with continu'd *striae*: The third substance was the *pelvis* itself, furnish'd with four caruncles; a thing which deserves to be more carefully examin'd. However, the reason of this diversity easily appears; for, the first ruddy substance is that into which the blood pours, and is separated from the *serum*; but

Of the ventricle
spleen, and liver

Of the gall.

Of a remarkable
glandulous body
in the mesentery.

Of the kidneys.

but the whitish *striae* are the *tubuli*, thro' which it flows into the *pelvis*; for, these *striae*, a thing first discover'd by *Malpighi*, may be plainly seen in this subject, tho' not in larger subjects.

Of the genital
parts.

11. But the most surprising things were observable about the genital parts; for, 1. The *penis*, as is usual in animals, lay almost entirely hid; and it was very long, so as to be almost half as long as the animal itself. 2. The *testes* did not hang down, but lay under the skin, and were bigger than the kidneys. 3. The *parastatae* did not only adhere to the *testes*, but as they could not contain them, great part of them was moreover included in a peculiar *saccus*, consisting of fleshy fibres; and from this *saccus* at length came out the *vas seminale*. 4. Bodies, externally manifestly fleshy and consequently very ruddy, and internally nervous, were furnish'd with a very hard nervous channel, which was inserted apart into the *penis* long before the *vesiculæ seminales*: Besides, 5. About the bladder, which is very thick, rugous and nervous, was observ'd another globose body, externally fleshy, internally nervous, and situated in the *penis* itself, into which as there was both a passage from the bladder, and as the *vasa deferentia* terminated therein, it hence appear'd, that they were the *prostate*. But at length, after this insertion, those nervous canals ran apart from the said round bodies into the *penis*. And this was the state of the genital parts in this animal, wherein such a surprising *apparatus* justly claims our admiration; seeing as to other animals, besides very small *testes*, whose *parastatae* are *appendices*, and besides the *prostate* and *vesiculæ seminales*, nature has furnish'd them with nothing else: Whereas she has supplied this animal with very large *testes* and *parastatae*, &c. and besides, a new feminal body, different and separate from these, and furnish'd with new ducts; as also a *penis*, the longest, if I mistake not, in any animal. From which we may gather, that this despicable and mean animal has, beyond all others, an extraordinary pleasure *in coitu*: But it principally deserves regard, that all these parts are defended with fleshy integuments, from which it is manifest, that they are contracted, and thus propel the feminal matter; and that it may not be stopp'd, it is to pass thro' nervous parts, and such as are not at all apt to yield; for otherwise, by their sides easily ceding, that passage would be weaken'd; so that the seed could not reach the destin'd parts: And here we may wonder, that no anatomists have observ'd, that in man the *semen* is protruded into the *vulva* entirely by pulsion, from whatever cause that pulsion arise, and that with so great a force as to be thrown a pretty way, which could not happen without a very great and singular effort. Whence I suspect, that our knowledge of the genital parts is not hitherto compleat; but that there still remains something which propels the *semen* with some degree of *impetus*. What it is in this animal is plain; and since in our body all motion is perform'd by muscles alone, I imagine the same thing here, yet I cannot at all think that it is done by the *erectores penis*.

12. In

12. In the *thorax* is found neither *pericardium* nor *mediastinum*, but the heart is forced to the left side, the lungs being placed on the right, and, which is surprising, below the heart: Whether this was preternatural in this mole I cannot say, however the cause thereof is not evident. Of the heart and lungs, &c.

13. The *vena cava* proceeding from the heart, not at the back, but thro' the middle cavity of the *thorax*, hung freely every way and passed to the liver. I observ'd a peculiar mechanism in the make of the feet; for, as has been already said, only the extremity of the feet appears out of the skin, which are broad and furnish'd with short toes, but strong and fitted for motion, and arm'd with claws to dig the earth; yet I found all the other parts conceal'd internally under the skin. Next the foot, properly so call'd, is a twofold bone which is evidently to be call'd the *radius* and *cubitus*; but instead of a *humerus*, there is a broad triangular bone, left by its roundness it should compress the subjacent parts, and instead of a *scapula*, because it wanted room to extend itself breadthwise, there is a pretty long bone, which is by a very strong ligament connected on the back with the *scapula* of the other side; and these were furnish'd with a great number of muscles. The glands appear'd both very large and numerous, so that in proportion to its bulk no animal methinks has so many and so large glands; and probably, these are placed here to facilitate by their continual discharge the motion within the skin; for, here they are collected together, which in other subjects run out very far, without the skin. Of the *vena cava*, feet, &c.

14. In examining into the auditory organ I found very small bones and cavities, together with a *tympanum*, but without an external ear, seeing it is not necessary here to collect the auditory rays from afar; yet it hears nearer sounds distinctly enough. The *meatus auditorius* is cartilaginous, flexible, and pretty long. Of the organ of hearing.

15. Eyes I found none, only rudiments of eyes, to wit, a small, but harder, black point, and, if I mistake not, solid, which has no communication with the brain, but is entirely external, and, as I said, lies conceal'd under a very thick skin. With these it does not see, nor could it under ground: But whether it perceives the rays of light in any measure, cannot be known, nor is it of any importance. Of the eyes.

The Elephantiasis and Phthiriasis cur'd by Mercury. By Joh. Lindestolpe. From the Acta Literaria Sueciæ. Trimestre IV. An. 1723. p. 476.

Translated from the LATIN.

ONE Peter Hook, a sailor of Enecoping, labouring under an *elephantiasis*, was scaly and rough all over his body, his eyes hollow, with red pimples on the end of his nose, his mouth and tongue black, his lips blub- Mercury us'd in the Elephantiasis.

blubber'd and turn'd inside out, his body emaciated, and his legs very slender, and when he spoke he peep'd like a chicken, he stunk intolerably, and had a very disagreeable aspect. I saw that gentle remedies could have no effect: I, therefore, proceeded in the following manner; after having first administer'd a gentle purge, by which the patient discharg'd some long white worms, I anointed his joints with a gentle mercurial unguent; whence on the second day his mouth smarted, his face seem'd to be heav'd and his gums swoln, and he gradually began to salivate: And thus as his salivation daily increas'd more and more for 12 days together, the crusts began to fall off, and the skin to scale: But as he happen'd to scratch himself very much, there were thereby produc'd *phagedænæ* and wounds of a very bad nature, which yet were dried up by an inunction of a mercurial cosmetic: And thus he was cur'd. But I was told he died the following year, either from the leprous venom not being well cur'd, or from the mercury falling upon his lungs.

The cause of this distemper.

Strangers will be surpriz'd to find, that such disorders should happen in so northerly a climate as ours, as they are only peculiar to more southerly places; yet the hospitals of *Helsingfort* in *Nyland*, at *Carlsbafen* in *Ostrobothnia*, and a great many villages of the parish of *Wendoo* are almost yearly full of such patients: And this distemper is only owing to their eating of young sea-calves, which are reckon'd great dainties in those parts: There was formerly a great difference between the leprosy of the *Arabs* and that of the *Greeks*; as in the former the humours were very acrid and putrid by the excessive heat of the sun; but in the latter, as from their somewhat more northerly situation, the humours were milder: Besides, some part of *Arabia* is wash'd by the sea, but *Greece* as to the greatest part thereof: I would not therefore readily advance, that in both nations the same distemper proceeded from the same cause. I could readily think, that the *Greeks* contracted this distemper from their eating of fish and sea-calves: But it seems probable, that the *Arabs* became leprous as *Jews* from their eating of bacon.

Mercury us'd in the *phthiriasis*.

One *Nicolaus Lund*, a mariner, labouring under a true *phthiriasis*, was sent into the hospital: As I view'd him for the first time, I found him emaciated and very weak, and almost all his body full of ulcers, which swarm'd with lice, that form'd in each ulcer a hemispherical cluster, which could not easily be separated: It was about the close of *August*, and the cold season was approaching. After anointing the patient for three evenings with a mercurial unguent he began to salivate; and such of the lice as survived began to fly into a corner of the room, where creeping one upon another they form'd a ball as big as a child's head; and the patient was cur'd.

Instances from antiquity.

The ancients, as in many other things, so also in this, have left us upon record no contemptible instances. The *Greeks* tell us of the poets, *Alcmanus* and

and *Pherecydes* having died of this distemper. *Pliny* relates, that *Lucius Sulla*, a Roman senator, died of a like disease. In the II^d book of *Maccabees* we read, that King *Antiochus* died also of it. And *Josephus*^a testifies, that *Herod*, the father of *Archelaus*, died in a miserable manner by vermin, which continually multiply'd in the putrify'd member: Besides, *Pomponius Lætus* relates, that the Emperor *Maximinus* died of vermin coming out of his groin.

^a *De bello Jud. lib. I. c. 21.*

A general method of determining the points of station of the Planets in their Orbits. By J. Hermann. From the Miscellanea Berolinensia. Tom. I. p. 197. and Tom. II. p. 59.

Translated from the LATIN.

A *Pollonius Pergæus* formerly applied himself to this astronomical problem, viz. to find the places of the planets in their orbits, when one appears to be stationary with respect to another, and he hinted what geometricians should effect to be assisting in this case to astronomers: But in the judgment of *Kepler* he neither perform'd himself what he wanted of others, or if he had perform'd it and solv'd the problem, he would not in that matter have satisfied astronomers; for, of the many causes of the variety in the limits of these stations, he has added but a few things, and left more untouch'd.

This problem attempted by *Apollonius*.

Kepler, resuming this problem, was satisfy'd with an astronomical approximation, without being solicitous about a rigorous geometrical solution; for, after various trials he deduced the angle comprehended between the *radius vector* (drawn thro' the sun and superior planet) and the line of vision, that is, he found the planet's elongation from the sun; and that by a method which is of great affinity with the rule of *position*, or the rule of *false*.

By *Kepler*.

In this whole disquisition he suppos'd the orbit of the planet and the plane of the ecliptic to be in the same plane; and that both the orbits were concentric circles; by which supposition the *calculus*, being surprisingly facilitated, does not, it is true, exactly exhibit what is sought, yet pretty near the truth, which may satisfy astronomers.

Before him *Nicolaus Copernicus*^a, handling this problem with his usual sagacity, accommodated *Apollonius*' notion, which was founded upon *Ptolemy*'s system, to his own hypothesis (which it seem'd to contradict) of the motion of the earth and the immobility of the sun in the centre of the annual orbit.

By *Copernicus*.

^a *Lib. 5. c. 35. de revolution. Orbium cœlestium.*

At

By Dr. Gregory.

At length *David Gregory*, in his *geometrical elements* of astronomy^b, has devis'd another method of determining the points of station, which he contends to be very much adapted to a calculation; yet he has only hinted at the principle of the arithmetical *calculus* without compleating it, and with other astronomers has suppos'd the orbits of the planets to be concentric and in the same plane; which hypothesis renders the problem very simple and very easily solvable.

By Dr. Halley.

But I know of none, who has exhibited a general solution of the problem, founded on *Kepler's* elliptical hypothesis, and extended to orbits, inclin'd to each other under given angles; yet we are to except Dr. *Halley*, who in a letter of M. *De Moivre's*, writ to me some time ago, is said to have given a general solution of this problem; yet *De Moivre* said he had not seen that solution. I propose to attempt the same problem, and, as I hope, not entirely without success.

A solution of the
problem in its
simplest case.

1. A *station* is thus defin'd by astronomers, namely, that it is such a situation of two planets with respect to each other, that the line of vision, drawn thro' the centres of the planets, may fall on the same point of the zodiac, with respect to longitude, as it did the day before: But these lines of vision cannot fall on the same point, but they must be either parallel, or at least be found in parallel planes; should it happen otherwise that one of them should tend to one point and another to another point of the zodiac, this would be contrary to the above definition. The problem may be thus generally conceiv'd,

Fig. 8. Pl. IV.

2. Two planetary orbits, either circular or elliptical, CYWH, DZXA, being given in position, whose semi-axis let be CG, DK, to find in their circumferences two points H and B of such a nature, that the planet B passing in any small time from *b* to B; but the planet H in the same small time from H to *h*, the line of vision *bH* may acquire by this motion a situation parallel to the former B*b*. In *Kepler's* hypothesis the orbits YWQ, ZXA will be elliptical, whose common focus is M, and let MX be that line wherein the planets W and X are when they began their motion together towards G and A; join the points *bM*, *hM*.

3. I shall presently shew, that the triangles BM*b*, HM*b*, are to one another in a given ratio; for, it appears, that the triangle BM*b* is to the triangle HM*b* in a ratio compounded of the ratio of the triangle BM*b* to the whole area XBZX, and of the ratio of the area XBZX to the area WHYW, and of the ratio of the area WHYW to the triangle HM*b*; but the area XBZX is to the triangle BM*b* as the periodical time XBZX to the periodical time B*b*, and the triangle HM*b* is to the area WHYW, as the periodical time H*b* to the periodical time WHYW; and because the periodical time B*b* is equal the periodical time H*b*, it will be the triangle BM*b* to the triangle HM*b*, in a ratio com-

pounded

pounded of the ratio of the area $XBZX$ to the area $WHYW$, and of the ratio of the periodical time $WHYW$, to the periodical time $XBZX$, which is as the area $XBZX$, multiplied into the periodical time $WHYW$, to the area $WHYW$, multiplied into the periodical time $XBZX$; therefore, the triangle BMb is to the triangle HMb as the area $XBZX$ divided by the periodical time $XBZX$ is to the area $WHYW$ divided by the periodical time $WHYW$, which is a given ratio, and let it be call'd n to c . Q. E. D.

4. Before we proceed any farther we propose to give the solution of the most simple case of the problem, which is when the orbits XBZ , WHY , are circular, concentric and in the same plane; then the points MCD will coincide, that so a figure may arise, where the two circles ABZ , GHY , have a common centre C ; let the semi-diameters CG , CA , be call'd a and b ; and let the planets be in the points G , A , of the right line CA , as they are suppos'd to begin their motion together and move towards B and H : Moreover, let us suppose the velocity of the planet A to be to that of the planet G , as n to 1 ; let fall on the line HB produced towards H the perpendicular CM : Which being suppos'd, let $MH = p$, $MB = q$. Now on account of the similar triangles $H\phi b$, HMC (ϕb being perpendicular to HB , as well as $b\beta$ is) it will be HC to HM as Hb to $b\phi$; and because the triangles $Bb\beta$, BCM are similar, it will also be BM to BC as $b\beta$ to Bb ; and multiplying the terms of each analogy it will be $HC \times BM$ to $CB \times HM$, as $Hb \times b\beta$ to $Bb \times b\phi$; but by the hypothesis $b\beta = b\phi$, it will be $HC \times BM$ to $CB \times HM$, as Hb to Bb , as 1 to n , as aq to bp ; therefore $naq = bp$. From the point B draw the tangent BL and let it be call'd c , and it will be $qq - pp = cc = bb - aa$; therefore, in the equation $nnaaqq = bbpp$, instead of pp let its value $qq - cc$ be substituted, and it will be $nnaaqq = bbqq - bbcc$: Whence

$q = \sqrt{\frac{bc}{bb - nnaa}}$; and $p = \sqrt{\frac{nac}{bb - nnaa}}$: Hence the square of $CM =$

$\frac{aaabb - nnaa^2 - nnaacc}{bb - nnaa}$ (in which if $bb - aa$ be substituted instead of cc) =

$\frac{1 - nn \times aabb}{bb - nnaa}$ (or putting mm instead of $1 - nn$) = $\frac{m m aabb}{bb - nnaa}$; therefore,

$CM = \sqrt{\frac{mab}{bb - nnaa}}$: Now if the sine total be call'd r , it will be CH to

CM , as r to the sine of the angle CHM ; therefore, $\sqrt{\frac{mbr}{bb - nnaa}} =$ the sine

of the angle CHB , or of the elongation of the planet B seen from H , and

$\sqrt{\frac{mar}{bb - nnaa}} =$ the sine of the angle CBH , or of the elongation of the planet

H seen from B : But $\frac{mbcr - mnarc}{bb - nnaa} =$ the sine of the angle of commutation

HCB ; and because the arch BA is to the arch HOG as n to 1 , it will be $n \times HO + n \times OG = BA$: But BA and OG are similar arches: Whence

BA

Fig. 9. Pl. IV.

BA is to GO as b is to a , as CA is to CG; therefore $\frac{b \times GO}{a} = BA$:
 Whence $n \times HO + n \times GO = \frac{b \times GO}{a}$ or $GO = \frac{n a \times HO}{b - n a}$.

Construction.

Hence the problem will be thus constructed; let the angle ACB be form'd; which let be to the angle of commutation HCO, already known from its sine, as na to $b - na$, and let the angle HCO be made equal to the known angle of commutation, and the lines CB, CH, will cut their circles in B and H, which indicate the places from which one planet will appear stationary to another, and the line HB joining these points, will be the line of vision sought Q. E. I.

Bernoulli's method.

I shall farther add a still more simple method of solution, which Bernouilli communicated to me.

Plate IV. Fig 9.

6, In the same figure let the tangents BT, HT meeting together in T be drawn thro' B and H: Now because bb is parallel (by the hypothesis) to HB, it will be TB to TH as Bb to Hb, as n to 1: Whence is immediately deduced $BT = \frac{nc}{\sqrt{1-m}}$, and $HT = \frac{c}{\sqrt{1-m}}$. Retaining the same symbols, as before, the rest will be easily deduced from what we have explained above.

A general method of finding the points of station in an ellipsis.

The general method of finding the points of station of the planets in the elliptical hypothesis, and where the orbits are variously inclin'd to each other, is as follows.

Fig. 10.

7. Let the ellipsis AKB be the orbit of any planet, and EIG the projection of the orbit of another planet in the plane of the former, which will likewise be an ellipsis or a circle; I and K are the places reduced to the same plane, when one planet appears in conjunction or opposition to the other with the sun in the common focus C; if the area KCB being always to the area ICG in the given ratio of n to 1, the points G, B, be join'd by the right lines GB, both the planets proceeding together from the points I, K, or from such as correspond to these in their orbits, will be always found in the right lines GB; and if besides, describing at the same time the infinitely small arches Gg and Bb, they arrive to the situation of the line gb, which produced will meet the other GB some where in O, by an infinite number of such interfections there will be form'd some curve line, which by its various flexures will shew when one planet seen from the other shall appear direct, retrograde, and in fine, stationary; this last case obtains as often as GB coincides with any asymptote of the curve; or which comes to the same thing, as often as the point of concurrence O is at an infinite distance from the points G and B: But that the magnitude of the line GO may be had universally; let GB and BR the tangents of the ellipses meeting in the point R, be drawn thro' G and B, on

B, on which let fall from the focus C of the ellipses the perpendiculars CP and CQ; and in fine, let the small line G γ be drawn parallel to the tangent BR. Which being suppos'd, because the triangles G γ O and BO b are similar, it will be G γ to B b as GO to BO (or assuming the common line GR) as GO $\times$ GR to BO $\times$ GR; and the similar triangles gG γ and GRB give Gg to G γ as GR to BR (or assuming the common line BO) as BO $\times$ GR to BO $\times$ BR; therefore, *ex æquo*, Gg is to B b as GO $\times$ GR is to BO $\times$ BR: But the triangle BCB is to the triangle GCg, as n to 1, as B b $\times$ CQ to Gg $\times$ CP; and therefore, Gg is to B b as CQ to n $\times$ CP: We shall, therefore, at last have GO $\times$ GR to BO $\times$ BR, as CQ to n $\times$ CP; and multiplying the extremes and means, n $\times$ GO $\times$ GR $\times$ CP=BO $\times$ BR $\times$ CQ; and at length we shall obtain this analogy, GO is to BO as BR $\times$ CQ is to n $\times$ GR $\times$ CP; and by conversion GB is to GO as BR $\times$ CQ $-n$ $\times$ GR $\times$ CP is to BR $\times$ CQ; and therefore, GO will be equal $\frac{GB \times BR \times CQ}{BR \times CQ - n \times GR \times CP}$. Now because this fraction cannot be infinite, unless its denominator be infinitely small or nothing; therefore, that one planet may appear stationary from another, the denominator BR $\times$ CQ $-n$ $\times$ GR $\times$ CP must be nothing; or which comes to the same thing, BR $\times$ CQ must be equal n $\times$ GR $\times$ CP, which indicates, in the case of the station of the planets, that the triangle BCR or half the rectangle BR $\times$ CQ is to the triangle GCR, half the rectangle GR $\times$ CP, in the given ratio of n to 1, or in the ratio of the trilinear BCK to the trilinear GCI.

Before we conclude, we shall communicate to the curious a very easy solution of the problem about the station of the planets revolving in circular and concentric orbits, which requires no calculation; and yet by means of which the problem is solv'd by plain trigonometry.

8. Let, therefore, the circles BZ and OY be concentrical about the centre C, and in the points B and H of the circumferences let the planets be found, when the one appears stationary to the other; draw CB and CH, and letting fall the perpendicular CM to BN, let HP be drawn thro' the point H parallel thereto, meeting the radius CB in P, from which point, as also from the point O let PR and OQ be drawn parallel to the right line BN; which being done, since the right line $b\bar{b}$ connecting the extremities b and $\bar{b}$ of the infinitely small arches B b , H $\bar{b}$, describ'd by the planets in the same time, is parallel to the other BH, the small right lines $b\beta$ and $\bar{b}\phi$, drawn thro' b and $\bar{b}$, will be parallel to MC and equal: And besides because the triangles B $b\beta$, CBM and COQ are similar, it will be B b to $b\beta$, as CQ to OQ; and the similar triangles H $\bar{b}\phi$ and HCM give $\bar{b}\phi$ or $b\beta$ to H $\bar{b}$, as HM or PR to HC, or OC; therefore, *ex æquo perturbatè* B b is to H $\bar{b}$ as PR to OQ: Now the small arches B b , H $\bar{b}$ describ'd in the same time, are as the velocities with

An easy solution of the problem in circular orbits by plain trigonometry.

Construction. Pl. IV. Fig. 113.

with which they are run over; therefore, $\frac{PR}{OQ}$, or $\frac{PC}{OC}$ is equal to the velocity of the planet B divided by the velocity of the planet H; therefore, putting this ratio of the velocities as 1 to n , it is only necessary to divide the radius OC in P, that the part PC be to the whole OC as 1 to n , and bisecting the remainder BP in S, from this centre and with the distance SP or SB, be described the circle BHP, which will cut the inferior orbit OY in the desired point H. Q. E. F.

9. But the angles in the triangle BCH will be easily found by plain trigonometry; for, because the radii BC, OC are given, a part thereof $\frac{OC}{n}$, which is PC, will be given in the same manner as PB and its half SP or SH; therefore, in the triangle SCH there are given three sides, as SC, half the sum of the lines, BC and PC, SH or SP, half their difference, and in fine, CH the radius of the circle OC; therefore, by the known rules of trigonometry, from those three sides the angles may be found as SCH and CSH, or its half CBH, from which shall also be found the third CHB or its supplement CHM to two right angles.

Of the Manufacture of China-ware. From the Breslaw Collection, October, 1717. Class V. Art. III. p. 242.

Translated from the HIGH-DUTCH.

An account of
porcelain and its
ingredients.

THE annals of *Feouleam* (according to *F. d'Entrecolles*, one of the missionaries to *China**) relate, that ever since the second year of the reign of the Emperor *Tam* or *Te*, that is, according to our manner of reckoning, since the year of *Christ* 442, porcelain has been wrought for the emperors of *China*; yet it is probable, that it might have been in use before that time, and be gradually brought to perfection and us'd by the richer *Europeans*. In the above annals there is no mention of the author of porcelain, or what gave rise to it, only that it was of the most beautiful white colour, and that the vessels made of it were call'd the precious jewel of *Jaotcheon*; yet the finest porcelain, both as to white and blue colour, comes from *Kimtetchim*, from which place the emperors would fain carry the manufacture to *Peking*, but without success. *Kimtetchim* alone has kept its reputation; and it supplies the whole world with porcelain; and from thence the *Japanese* have it. Porcelain is not properly a *Chinese*, but a *Portuguese* word, and denotes a *bowl* or *cup*: Whereas in *China* porcelain is commonly call'd *Tshki*. The matter of porcelain consists of two sorts of earth, one of which is call'd *Petuntse*, the other *Kaolin*; the former is mixt with some sparkling particles; whereas the latter is entirely white and feels very soft. Both sorts are in form

* *Recueil* XII. des lettres edifiantes & curieuses des Missionnaires à la Chine.

form of tiles brought in ships from *Kimuen* to *Kimtetchim*; for, *Kimtetchim* yields no materials for porcellain: And the *Petuntse* is nothing other than pieces of rock, which are brought in the above form. The first process consists in this; the stone is first beat small with an iron mallet, then put into a mortar and powder'd very fine, afterwards it is thrown into a large vessel full of water and strongly stirr'd about with an iron *spatula*, then it is suffer'd to rest a little, and there arises a-top a sort of cream, which is taken off and put into another vessel full of water, and ready for that purpose: In the mean time the matter in the first vessel is kept stirring a-new, and the cream is taken off in like manner: The gross matter that falls to the bottom is again beat small, and the stirring and skimming is repeated as above, till at last no more of this subtle matter is obtained. Now when this fine matter uniting together in the second copper or vessel settles gently to the bottom like a dough and the clear water is gently pour'd from it, this dough is put into particular moulds, dried and afterwards divided into small-square pieces, which, on account of their figure and colour, are call'd *Petuntses*; but as these are usually adulterated by the *Chinese*, they must be at last brought to *Kimtetchim* in order to be purified a-new.

The *Kaolin*, as the second ingredient of porcellain, requires less trouble than the *Petuntse*: It is found in lumps very deep in the mountain, and cover'd with a reddish earth, and it is work'd in the same manner as the *Petuntse*, and reserv'd for farther use in the porcellain manufacture. *F. d'Entrecolles* is of opinion, that the white earth from *Malta*, commonly call'd *terra S. Pauli*, is of the same nature and goodness, yet without any of those silver particles in this last as are observ'd in the *Kaolin*. This *Kaolin* gives the porcellain its hold, and is on account of its softness very servicable to the hard stony *Petuntse*; and hence as the *Dutch* and *English* once brought the *Petuntse* to *Europe* in order to make porcellain, they could not succeed therein, as they did not bring along with it the *Kaolin*. Both these ingredients are carried by water to *Kimtetchim*, as also another whitish and fluid substance, which gives the porcellain its perfect whiteness and gloss, and which *F. d'Entrecolles* takes for that sort of oil, which in *Cbina* is call'd *Tsy*, and in *Europe* varnish, which also comes from stones as the *Petuntse* does; and such stones yield the best oil as have spots like the leaves of the cypress, or such as are red spotted and whose ground appears dingy: But this petrol is not only employ'd therein, but likewise another sort, which gives it its very soul as it were. The composition is as follows, large pieces of quicklime are slack'd by sprinkling water thereon, so that they fall to a powder, on which is made a layer of dry ferns, and on that a new layer of unslack'd lime, and thus alternately; after which the ferns are set on fire; and when the whole is consum'd, this ash is divided into new such layers with more ferns, and this for five or six times successively; and the oftner

this is done, the better the oil is: Besides these ferns, as the history of *Feouleam* mentions, they also make use of the wood of a certain tree; whose fruit is call'd *setse* and which F. *d'Entrecolles* takes for a kind of medlar-tree; but which is now no longer us'd therein, as it is, perhaps, become scarcer. Whence, probably, it comes, that the modern porcellain is not so beautiful as the ancient. This ash of lime and fern is thrown into a vessel full of water, and one pound of *chekao*, which resembles alum, is always dissolv'd in 100 pound of the water, and the whole is well stirr'd together and suffer'd to stand till a thickish crust settle a-top: This crust is taken off and put into another vessel, and then a paste settles to the bottom, from which the clear water is pour'd off; and so this other oil is mixt with the first, both which must be of a like thick consistence; and the best mixture consists herein, that to 10 measures of the above petrol, there is taken one measure of this other oil, which is made of lime and fern. The making of the porcellain itself requires a great deal of labour; and one piece, before it is put into the furnace, must go thro' 20 hands, yet without any disorder or confusion. They first purify a-new the *petuntse* and *kaolin*, as was mention'd above, of both they take equal parts to the fine porcellain; to the middling sort four parts of *kaolin* and six of *petuntse*; and to the worst sort one part of *kaolin* and three parts of *petuntse*. The masses are shot into a well cemented vessel, and then kneaded to their due degree of hardness. Of these are taken pieces, spread upon a broad plate and further kneaded and roll'd, yet so that no grain of sand or hair mix therewith, as these mar the work. After this at last the porcellain is either wrought upon the wheel or barely in certain moulds, and at length finish'd with a knife, almost in the usual manner of our earthen ware; yet so that each piece must pass thro' 60 hands, before it attains to its perfect form. The porcellain is afterwards varnish'd and bak'd, after which it is painted and gilded, and then bak'd once more. All this process must by no means be perform'd in the cold, and great care must be taken that all be equally dry, in regard the contain'd moisture makes the porcellain spring; for which end, therefore, they sometimes make a fire in their work-houses. As to the painting, the masters therein, who in general are no great artists, yet deserve some praise in painting porcellain, are call'd *hoapei*. This painting goes also thro' many hands, one of whom makes the outmost circle round the rim, a second sketches out the figures, which are coloured by a third, &c. The colours themselves are of different sorts; and in particular the figures on a white ground are more beautiful than any we have in *Europe*. Formerly there was only white porcellain before they found out the blue, which is now us'd in this work, and which was discover'd by a dealer in porcellain, upon his being shipwreck'd on a desert coast, where were found many stones yielding the finest blue, with which he load'd a whole ship. This colour, after stamping, is roasted for 24 hours in a furnace,

furnace, and then ground to a fine powder in a large porcellain mortar. The red colour is made out of vitriol, call'd *baofan*. They also have a peculiar sort of white colour, different from the porcellain white, and which is employ'd in some figures. It is, in like manner as the blue, burnt from a transparent marcasite, half an ounce of which is powder'd and mixt with a whole pound of cerufs; and afterwards employ'd in all sorts of colour-mixtures; as for instance, green, yellow, &c. These colours (according to the *Chinese* account) are laid with cerufs, salt-petre and vitriol; or (as the *Christians*, who work thereon, give out) barely with cerufs alone, on the porcellain bak'd for the first time, after first dissolving these in gum-water; and then the porcellain is once more bak'd, and the colours appear perfect. They make among other sorts a peculiar red-blown porcellain, which is more costly and rare than the others. The black also, call'd *oumi*, is not without its value and beauty. The gold gives a new lustre to this sort of porcellain. This black colour is imparted to it with three ounces of azure or blue and seven ounces of petrol: When this colour is dry, the porcellain is bak'd; and then the gold is laid on, after which the vessel must be bak'd a-new in a peculiar furnace. They also make a sort of china with holes, in whose middle is the bowl or cup for holding the liquors, as also another sort in which the *Chinese* and *Tartar* women are painted to the life: And when they give the porcellain no other oil than that prepar'd from the marcasite, it yields a peculiar sort thereof which is entirely marbl'd and furnish'd with veins, that one would take it for broken china; it is otherwise call'd *tsoniki*. The gold is rubb'd with gum-water and cerufs laid thereon. After the painting and gilding are dry, the china is put into the furnace, which when small may be made of iron; but it is commonly made of earth, of the height of a man and almost as wide as a large wine-butt; its bottom stands half a foot high from the ground; it is wall'd round and this wall is furnish'd with three or four air-vents: Now when the furnace is fill'd with the china-ware, besides one aperture in the middle, thro' which one may see the china, there is made a coal-fire above and below and on the sides, and the china bak'd so long, till it sparkles and the colours become lively, upon which the fire, and also the china are remov'd. The *Chinese*, however, very much regret their having lost the art of painting fishes and other beasts on porcellain, which could not be distinguish'd before the china was first fill'd with a certain liquor; and this sort they call'd *kiatfim*; and, according to F. *d'Entrecolles*, before the oil was laid on, the porcellain must have been previously polish'd to take off all the inequalities, and in the painting they made use of a pencil of the finest feathers, which they wetted and run over the china. The laying on of the oil itself requires much art, so that neither too much nor too little be given, but that it be equally laid on. Very thin porcellain has two coats of this oil; what is pretty strong only one. The former is done by sprink-

ling,

ling, but the latter by dipping, and on that the varnish is immediately laid; but the foot, which is solid, is previously bor'd and then painted, varnish'd and lastly brought to the furnace. The fire must be well managed, and all the china must, according to its bigness and strength, have its proper degree of fire, else the baking miscarries. The *Chinese*, according to F. d'Entrecolles, worship a particular God, who presides over the china, and whom they call *Ponfa*. The occasion of which was this: As once the emperor would have the porcellain wrought according to a certain form, but the impossibility thereof being in vain represented to him; and, after a great deal of trouble and expences, the thing appearing impracticable, at length one of the workmen out of despair jump'd into the glowing furnace, wherein he was soon consum'd, and upon this the porcellain was taken out exactly of the form the emperor would have it; and from this they rever'd this desperado as a great hero and a god, who presides over porcellain. The *Chinese* in particular highly esteem the old porcellain, tho' some prefer the new to it. And such as are fond of the old porcellain regard chiefly its colour. F. d'Entrecolles denies, that the porcellain, as has been hitherto thought in *Europe*, attains to its perfection after lying long buried in the earth: And the *Chinese* themselves laugh at this conceit. It is true, that in the rubbish of old buildings and in cleaning wells they have often found beautiful pieces of porcellain; but its beauty was not owing to its lying there, but barely to its retaining its ancient beautiful form; and this depends merely on the fancy of the *Chinese*, who are wont to give a great deal of money for such old china, especially such as the ancient emperors *Yao* and *Chun* made use of, who reign'd many ages ago, and at the time when the emperors first began to use china. The whole value of this old buried porcellain depends on its colour, from which its antiquity is known; and such a piece of porcellain has sometimes been sold in *China* itself for 80 rix-dollars. The mandarin of *Kimtetchim* has publish'd at court, that he was master of the art of making old fashion'd china, for which purpose he employs a yellowish earth dug up about *Kimtetchim*. That sort is very thick. The process differs little from the former, only that the oil for it is taken from a yellow stone and mixt with the common oil; from which the porcellain acquires a sea-green colour; after it is bak'd it is thrown into fat broth and bak'd once more; after that, it is laid in a common sewer, where it is suffer'd to lie for a month, and then it passes for 3 or 400 year old china. The *Chinese* have a peculiar method of mending broken china; with a diamond they drill a hole thro' the pieces; and put a very fine brass-wire or thread thro' the holes and fasten the pieces so firmly and with such nicety, as the crack can scarcely be observ'd.

A Description of a new and very uncommon Phenomenon observ'd in the Heavens in the beginning of Spring 1683, at Paris. By Joh. Cassini. From the Acta Eruditorum Lips. Anno 1683. p. 274.

Translated from the LATIN.

A Certain *light*, like that of the *milky way*, yet brighter in the middle and weaker towards the extremities, expanded itself thro' the vernal signs. I began first to observe it at the *Royal Observatory* on *March 18.* in the evening, two days before the equinox; when after having observ'd the changes which happen'd in *Saturn*, I fix'd my eyes on the first star of *Aries*, which thro' a telescope is seen as consisting of two stars, distant from each other the sum of their diameters. Three quarters of an hour after 7, and half an hour after the *crepusculum*, the constellations of *Aries* and *Taurus* were far brighter than usual. To the west that *light* was terminated only by vapours, elevated two or three degrees above the horizon, and its brighter part was eight or nine degrees in breadth, it was extended obliquely along the zodiac nearly, with its northern side touching the two brightest stars in the head of *Aries*, whose body it cover'd; in length it extended over the *Pleiades*, and gradually vanishing about the head of *Taurus*, it ended in a sharp point.

The history of this phenomenon.

In that tract the heavens were very clear, so that stars of the sixth and seventh magnitude could there be distinguish'd by the naked eye; and that brightness, in some measure resembling a small cloud, enlighten'd by the sun, did not hinder these small stars from being seen in its very middle, where it appear'd denser, as usually happens to those who view a-cross the tails of comets; yet its breadth was greater than that it could be reckon'd to be the tail of any comet, as being three or four times broader than the largest comets I have hitherto seen; as to the rest it resembled them not only in brightness, but in colour and in situation with respect to the sun, to which in length it was almost directed.

A little after it was also observ'd to follow the motion of the heavens towards the west; and being carried by this motion it continued in the same signs, and with them was hid under the vapours about the horizon.

I was in doubt, whether by its slow proper motion it was not carried northwards; for it afterwards took in these two brighter stars of *Aries*, which at first it touch'd with its northern side, which was afterwards verified by the observations on the following days; yet I could not be entirely certain of this either at that time or many days after, because the extremity of this *light*, being on every side too indetermin'd, became gradually languid, so that it was very difficult precisely to define it; besides, on account of the different clearness of the air on the ensuing days, according to

to the distance of the *crepusculum*, it was observ'd more or less extended: Whence on its first appearance, which happen'd an hour after sun-set, a more sensible *light* only diffus'd itself in breadth to the brighter stars of *Aries*, and in length to the *Pleiades*; both which it a little after possess'd: But as to its middle, as far as could be perceiv'd by the eye, it always appear'd in the same tract towards the middle of *Aries*.

After the constellations of *Aries* and *Taurus* had set, I continued observing whether any trace of this *light* still remain'd at that height and in that situation wherein it was seen, yet I found nothing uncommon there. From which it was manifest, that in its diurnal revolution about the earth it follow'd the above signs, in regard that on the ensuing days setting together with them, it was in the same place with them where it was seen the preceeding days, which according to the *Copernicans* is the same thing as to remain fixt in the same place of the heavens within the diurnal revolution of the elementary sphere from west to east about the axis of the earth.

In this state I, therefore, observ'd that *light* from *March* 18. to *March* 26. as often as the sky to the west was clear, without observing any sensible change, only that by the last observation of *March* 26. it did not extend so far towards the horns of *Taurus*, as it had done on the preceeding days; but seem'd to extend somewhat more northerly. The brighter star of *Aries*, which at first was close to its side, was now above a degree immers'd in this *light*.

In this last observation I could not discover the first star of this constellation, because it was lower and lay deeper in vapours, which at the same time diminish'd the expansion of the *light* to the west more than in the preceeding observations: It therefore appear'd, that, besides this impediment and that occasion'd by the *crepuscula*, it would happen, that in a day that *light* would be seen extended more towards the west and very near the sun, who about its beginning was in the last degree but one of *pisces*, only 30 degrees from the first star of *Aries*: And in the last observation of *March* 26. it was distant a little more than 22 degrees; so that if this *light* could have been view'd when the sun was up, it would probably place round him the appearance of a *bush of hair*.

From this time, the sky in the evening being overcast to the west, I could not certainly know, whether this *light* was dissipated, till on *April* 14, 22, 24, and 28, and then tho' (the *crepusculum* being over) *Aries* was now set, the same *light* appear'd in *Taurus* extending to his northern horn, and with its north side it reach'd *Medusa's* head and *Perseus's* south knee, whose south foot was immers'd in its brightness.

By these last observations, therefore, it appear'd far more evidently than by the preceeding, that this *light* advanc'd northwards, which was the reason, that it could not be so soon extinguish'd by the evening *crepusculum*, as the sun in the mean time was advancing to *Taurus*.

It will be a difficult matter in the history of past times to find a *phenomenon* in all respects like this new *light*, as it appear'd for several days in the same signs, without any evident proper motion, and so much extended, especially in breadth, and without the appearance of any comet, to which it might have ow'd its origin.

This *phenomenon* compar'd with other the like *phenomena*, together with a remarkable reflection about this matter.

Yet as to this last circumstance, and the other circumstances of its duration, state and direction towards the sun, greatly agrees what I observ'd at *Bononia* in 1668; it was a luminous track; or path, like the tail of a comet, which possess'd a space of 30 degrees in length, and little more than 1 degree in breadth.

On *March 10*. I observ'd it come out of vapours, which were near the horizon, and cover'd *Cetus*, with its east side directed towards *Orion's* foot, and with its west towards the place of the sun: Its length, as well as that of this *phenomenon*, was referr'd to the signs of *Aries* and *Taurus*; but it had a remarkable breadth southwards, and chang'd its situation among the *fixed* stars with a proper motion towards the east and towards the north, by which in a day it approach'd more to *Orion*. It appear'd till *March 19*. and in all these nine days it pass'd by different stars of *Eridanus*, yet so as not to cover them.

M. *Chardin* in his book of the coronation of *Solimann*, king of *Persia*, relates, ' that the same *phenomenon* of 1668 was observ'd in the metropolis of a certain province in *Persia* on *March 7*. which was the second day of its appearance, and at *Ispahan*, which is the metropolis of the kingdom, at 7 o'clock in the afternoon *March 10*. that it appear'd in the south, and follow'd the *primum mobile* with $30^{\circ} 32'$ in length, which agrees with our observation, and that it was every way equally broad 6 degrees nearly; which is 4 times greater than it appear'd to me at *Bononia*, where yet there were some who reckon'd it broader; yet it was a difficult matter to define its breadth, as towards the extremities it was weak and sensibly languid. M. *Chardin* adds, ' that its more elevated part lay towards the belt of *Orion* and towards *Eridanus*.'

It appear'd to me towards *Eridanus*, *Orion's* belt being far more northerly and westerly. The longitude of 72° which he gives it, and its latitude of 3° from the ecliptic do not differ from the above situation; in which numbers of M. *Chardin* it is plain there must be some mistake.

He subjoins, ' that *Cetus*, or the flexure of *Eridanus* bounded its inferior extremity; which exactly agrees with my observation, which places it at the belly of *Cetus*, where it touches the flexure of *Eridanus*. He says, ' that the *Persians* call'd it *Niazack*, that is, a *small lance*, from the resemblance of its figure; that they said, they had never seen nor heard from others of any such *phenomenon*, tho' it was reckon'd a comet, whose head was set, so that it could not be observ'd above the horizon.'

Yet

Yet on this occasion I have shewn, that this *phenomenon* had a surprising affinity with such another 2000 years ago, namely, with that which *Chalrimander*, according to *Seneca*^a, relates to have been observ'd by *Anaxagoras* of a great and uncommon *light* of the bigness of a large beam, which shone for several days; or with that which the same author says was observ'd by *Calisthenes* with the appearance of a fire extended in length, before the large cities of *Achaia*, *Buris* and *Helice* were in an earthquake swallow'd up by the sea, and which *Aristotle* took to be a comet; which at first, on account of its great burning, did not appear, but at last was seen when its burning abated a little.

Aristotle^b speaking of this *phenomenon*, which was observ'd in the heavens at the time of the earthquake and inundation in *Achaia*, at one time calls it a great comet and again a great star, and he relates, 'that it appear'd 'about the south-west,' as our comet also did; and after rehearsing many other instances of the like *phenomena*, he subjoins, 'that that great star 'appear'd in winter, in very cold weather, and in a very clear evening, 'the year *Aristæus* was *Archon* at *Athens*; that the first day it did not appear as it was set before the sun; that the following day it was seen but a little, as setting and leaving the sun at a small distance before it; that it 'extended its light to a third part of the heavens in form of a *lawn*, and 'that on this account it was call'd a *way*; that it ascended as far as the 'belt of *Orion*, and was there dissipated;' which also happen'd to the *luminous way* of 1668.

Seneca, who took this *phenomenon* for a comet, reprehends *Ephorus* for saying that it was divided into two stars, a thing he alone maintain'd, tho' it was observ'd all over the earth, and reckon'd a presage of the inundation of those two cities: Tho', therefore, the apparent magnitude of that *light* was certain, and supported by the testimonies of all observers, yet all do not agree in determining its species; as this has also been the case as to the like *phenomena* in our days.

There are other histories of ambiguous comets, of which there has only been seen a certain great *light*, such as was observ'd after *November 10.* till *November 23.* of 1618, towards *Hydra* in the southern hemisphere, before the remarkable comet which shone in the northern part of the heavens about the close of the above month, and lasted till the end of *January 1619.*

Of the nature of this light.

This uncommon *light* is not without its matter that emits rays to the earth, whether it be luminous of itself, or whether it reflects or refracts the rays proceeding from the sun, or from any other luminous body, either immediately or by means of other bodies: And indeed, its direction, which its length has to the sun, supplies a handle of affirming that it is deriv'd from the sun himself.

In

^a Quæst. Natur. Lib. 7.

^b Meteoror. Lib. 1. c. 6.

In the synopsis of my observations of the comet of 1681 N° 12. I have maintain'd, that a matter may be diffus'd in the *æther* fit to reflect light, as happens in our atmosphere; and that that matter may be found in the orbit of comets, where the *æther* is at different times more or less pure, and may produce the *phenomenon* of the tails of comets, and the other changes they undergo.

As, therefore, this *light*, both as to colour, clearness, tenuity, and as to its situation with respect to the sun, is like the light of comets, it is credible, that the matter, reflecting that *light* to us, is of the same nature; whether a comet be there conceal'd under the sun's rays, from which that *light* may take its rise (which yet I dare not assert, as this *light* differ'd so much in its breadth from the tails of all the comets hitherto observ'd) or whether it receives its rays immediately from the sun.

For, as we observe *phenomena* in the air produced by the refraction and reflexion of the solar rays coming immediately, and of other the like rays coming by the intervention of the moon, such as are rain-bows and *halo's* about one star or other; it will be no inconsistency, that the like *phenomena* may also be form'd by the sun in the matter dispers'd through the *æther*, either immediately, or by the interposition of some cometic body; that very matter may reflect to us the light of some star, such as happens to certain *fix'd* stars, which sometimes put on a *busb of hair*; which not only happen'd, according to the observations of the *Egyptians*, but *Aristotle* also testifies, that he observ'd the like himself. In this manner was seen one of the stars in the thigh of *canis major*, at first, indeed, more obscurely, yet by a more intent view, pretty manifestly.

We are to observe that our *light* appear'd in the same tract, which many comets of this age, namely, those of 1652, 1665, 1672, 1680, and many others of preceeding ages travers'd, *viz.* in that *fascia*, which, on account of the frequent passage of comets, I have call'd *zodiacon cometarum*.

As to the distance of the matter, which is the subject of this *light*, or the medium, by which it reaches our earth either by reflexion or refraction, it cannot be accurately enough determin'd by the parallax; especially on account of its ambiguous limits, which hinder'd the comparing it accurately with the *fix'd* stars at different hours of the night, and in different parts of the earth; yet that it is considerable you may learn from the circumstance of its diurnal motion in 24 hours, whereby it emulated the stars; for, in the common hypothesis what force of wind for a whole month together could propel this matter thro' the air without dissipation, with so great an *impetus*, as in one day to encompass the whole earth, and so regularly as always to regard the same stars? And in the *Copernican* hypothesis with what force could it continually resist the diurnal motion of the elementary sphere from west to east, so as neither to be carried along with it, nor dissipated thereby? We must, therefore, necessarily own, that this matter stands above

A conjecture about the distance of this luminous matter.

the elementary sphere; and consequently, in the *æther*; and likewise considering its proper motion, which was but very little, we shall be oblig'd to suppose, that it was very far elevated towards the region of the *fix'd* stars.

It was not without reason that the ancients judg'd, that such of the planets were more elevated towards the *fix'd* stars, as came nearer their common motion, and had a less degree of proper motion; nor had they any other reason of raising *Saturn* above all the other planets, and of placing *Jupiter* below him, of which no astronomer ever after doubted for more than 20 or 30 ages.

They were confirm'd in this by new hypotheses, which serve to represent the *phenomena* of their motions, however they may differ among themselves, and in some things contradict each other, as the *Copernican* hypothesis does the *Tychonic* and *Ptolemaic*: Each of these hypotheses demonstrates the order of the superior planets, establish'd by the ancients, by principles peculiar to them, as it is impossible to do this independently of any of these hypotheses; these two planets having no sensible parallax on account of the small proportion of the diameter of the earth, and that of their orbits.

It is not, therefore, incongruous to determine the situation of new objects in the world, by comparing their motion with that of bodies which are known to us; such as by the observations of astronomers are plac'd at different distances, according to the different degrees of their apparent velocity.

Of the German Moxa. By Georg. Wolfgang. Wedelius. From the Miscellanea Naturæ Curiosorum An. I. Dec. II. Obs. VI. p. 14.

Translated from the LATIN.

Moxa what? and its use in the gout

IT is not many years ago since the *Chinese moxa* was first known both to the world, and to the physicians of *Europe*. It is a new name and a new medicine, and chiefly cried up as a cure in the gout, that incurable, as is thought, or at least obstinate disease of the Great. It was first taken notice of by *Herman Buschovius*, he having publish'd a treatise about it in *Low* and *High Dutch*, to which here and there he has added experiments, partly successful and partly otherwise.

This author *de curat. podagræ part II. c. 4. p. m. 91.* says, that *moxa* is a downy and soft substance, prepar'd by art from a certain herb, whose name and preparation he knew not, yet that it was certainly the noblest of plants, and that it might justly be call'd *mater herbarum* (*mother-wort*). He adds, that the *Chinese* and *Japonesse* conceal'd the manner of preparing the *moxa*, tho' it may be had in great plenty.

Here

Here we meddle not, whether the author really did not know the herb and the manner of the preparation, or whether he fram'd this on purpose, to conciliate the greater authority to the medicine. Let it suffice, that he has given a broad enough hint of it to the intelligent: But both candour and gratitude, virtues we highly prize if found in a physician, do oblige us not to arrogate this discovery to ourselves.

Job. Hartmannus Kornmann Von Hornsbach, counsellor and chief physician to the Prince of *Hesse*, has discover'd to us both the herb and the manner of preparing *moxa*. *Moxa*, whencesoever it had its name, is the down of mugwort.

Take as much as you will of the leaves of mugwort, well dried and stript from their stalks; rub them with the hands, - till after shaking off the green dust, the internal downy fibres arranged beneath like a woof, remain behind; but if the hands are wetted by their humidity, the rubbing is to be repeated, till the fibres become sufficiently tender. The manner of preparing it from mugwort.

He discover'd this to be the manner of the operation upon examining a parcel of *moxa* sent him, wherein he found the small leaves adhering to the down, when view'd with a microscope, entirely to resemble mugwort; and making an experiment thereon, it succeeded to his mind, yielding a like down, or rather *moxa*. How discover'd.

He also farther improv'd it by teasing it in the manner of wool, that thereby it might become still better and more tender, and be alter'd the more: And therefore, if the *Chinese moxa*, done up with its aromatic stalks, does not directly agree with it in all respects, (externally indeed it does but not internally) but seems to differ from it a little, we are to reckon that the fault is partly owing to this, namely, that the herb was not gather'd at one and the same time, and partly that it was more slightly or more carefully prepar'd; but it is an easy matter to extract its greenness by pouring spirits of wine thereon; and after that to teaze the dried leaves with the common instrument for wool, and whiten them with alum-water, or even attempt it with the fume of sulphur. Farther improv'd.

That this is the genuine process is evinced by two extraneous arguments, to wit, the senses and the effect; both which testify that *moxa* is *moxa*; and by one argument founded on the author's own confession, tho' not at first sight obvious to the reader; for, in the above cited place he calls *mater herbarum* (*mother-wort*) the mother of *moxa*, but that the common broad leav'd mugwort is thus call'd by Botanists is very evident from the testimony of *Lobelius*, *Dodonæus*, and others. This matter evinc'd by several arguments.

But to illustrate this the more we are to observe, 1. That the down of plants is twofold; the one external, as in coltsfoot, the *gramen lanigerum*, knot-grass, and others: The other internal, as that in the root of colts-foot, which *Scaliger*^a commends for tinder, and such as is found in that well

H h 2

known

^a Exerc. 180. n. 2. p. m. 585.

known thing, lint; and such is also the *moxa* of mugwort. 2. That this method of curing pain by actual inustion is no new thing; which yet derogates nothing from its commendation, but rather adds weight thereto. We shall in this matter quote *Hippocrates* alone, the most ancient parent of medicine, who in his book *de affection. cap. 30. f. 12.* says, ‘if pain seizes on any one part and settles, and cannot be remov’d by medicines, burn whatever part the pain is in, but burn it with raw flax.’ And, indeed, both as to the matter, the disease wherein it is to be applied, and the method of cure itself, he could not have given a better description of *moxa*, which is so much cried up. And that this may the better appear, we are to observe, that, by *raw flax*, he does not mean such as has nowise been prepar’d, but what hitherto has not been drawn into threads. *Prosper Martianus*^b has learnedly and nervously describ’d the whole process, as follows: ‘Take raw flax, and rolling it up hard bring it into a pyramidal form; the place to be burnt will shew what should be the bigness or broadness of its base, and you must know, that the burning becomes somewhat broader than is the base of the pyramid; setting fire, therefore, to its top, lay it on the place to be burnt, and let it lie thereon till the whole is consum’d; for, the fire gradually coming to the skin causes a burn, and which seems surprising, almost insensibly and without any pain; after the fire is extinguish’d *Hippocrates* laid on a boil’d leek, till the *eschar* dropp’d off. In *Germany* they apply butter with a colewort, and afterwards the wound may be kept open at pleasure.’ This agrees in every respect with the modern matter of burning, *viz. moxa*; and in the above-cited place may be seen the several matters with which others have perform’d successful burnings. The same effect is produc’d by any dry, filamentous, or lanuginous and porous bodies, by cob-webs (by applying which, in the same manner, the above gentleman has taken off warts from the hands without any pain; the wart being taken off after burning, and laying on a plaister, in a day or two the cure is compleated) by the spunk of trees, the pith of rushes, of elder, &c. 3. That the burning by *moxa* is of greater service in deep pains, and such as are not accompanied with heat and redness. It has been observ’d to have been of excellent service to some, and of detriment to others, nay, to have threaten’d a gangrene. The same discretion, therefore, is entirely necessary here as in vesicatories, or even actual cauteries. This kind of remedy will with safety be of greater service where there are ferous, cold, consistent humours (there being no contraindication) to be discharg’d and consum’d. But if you promiscuously apply it, the disease may be easily heighten’d, and become worse; whereas, on the contrary, by giving an outlet to the *ichor*, this remedy may be of service above all other things, making a discussion at the same time that the part itself is in some measure strengthen’d by the burning.

Cor-

^b *Comm. in Lib. de affect. f. 2. v. 25. p. 170.*

Corresponding Observations of the Eclipses of Jupiter's Satellites in different Parts of Europe, with Remarks thereon, as also a Remark, wherein in particular is deduced almost the whole extent of Europe in Longitude, &c. From the Commentar. Scient. Imper. Petropol. Tom. I. p. 467.

Translated from the LATIN.

Anno	N. S.	True Time.			
1726	July 10.	12 ^h	47'	0"	The immersion of the first satellite observed with Campani's tube of 15 foot: But the excessive brightness of the <i>crepusculum</i> at that time and other things besides, marr'd the observation. Whence the time could not be defin'd beyond minutes.
	Aug. 9.	14	51	30	The immersion of the first satellite observed with the same tube of 15 foot, and with another of 20 foot and a half; but for the same impediments as above, the time assigned cannot be depended on, within a quarter of a minute.
	18.	11	15	46	The immersion of the first satellite by a tube of 15 foot.
		11	15	52	By a tube of 20 foot and a half, the sky serene, the air calm, and the moon not far from <i>Jupiter</i> .
	Sept. 10.	11	32	51	The immersion of the first satellite by a tube of 15 foot.
		11	32	56	By a tube of 20 foot and a half, the weather very serene and calm.
	22	16	13	20	The immersion of the second satellite by a tube of 15 foot, the weather pretty serene, notwithstanding there were a few small clouds.
	Oct. 19	12	21	46	The emerision of the first satellite by a tube of 15 foot; and the satellite very near <i>Jupiter</i> .
	28	8	47	8	The emerision of the first satellite by a tube of 15 foot, within a few seconds.
	Dec. 6	7	11	18	The emerision of the first satellite by a tube of 20 foot and a half.
		10	30	31	The emerision of the second satellite by a tube of 20 foot and a half, exact.

At Petersburg by
Jos. Nic. de
L'isle, and Lud.
de L'isle de la
Croyere.

Amo

Anno	N. S.	True Time.			
1726	Dec. 6	10 ^h	30'	38"	By a tube of 15 foot, exact.
		29	7	15 36	The emersion of the first satellite with a tube of 20 foot and a half, exact.
1727	Jan. 2		7	15 48	With a tube of 15 foot, exact.
			10	59 46	The immersion of the third satellite by a tube of 15 foot, the sky foggy.
			11	0 17	By a tube of 20 foot and a half; and I think this other observation more certain and exact within a few seconds: And tho' the sky seem'd serene, yet <i>Jupiter</i> appear'd not so distinctly, as he was wont to do at other times, because he at times pass'd thro' vapours, which disfigur'd him and tinged him with colours.
			7	10 9 56	The emersion of the second satellite by a tube of 20 foot and a half.
				10 10 4	By a tube of 15 foot.
	Febr. 1		7	17 15	The emersion of the second satellite by a tube of 20 foot and a half, exact.
Aug. 5		11	52	23	The immersion of the third satellite by a tube of 22 foot, the sky serene and calm; but the slow motion of the satellite hinder'd the certainty of the immersion to some seconds; 4 or 5 minutes had already pass'd from the beginning of the diminution.
		7	10	59 27	The immersion of the first satellite by a tube of 22 foot; but <i>Jupiter</i> being very near the horizon, marr'd the observation.
		8	13	37 9	The immersion of the second satellite by a 22 foot telescope.
		21	14	50 30	The immersion of the first satellite by a 22 foot telescope.
		30	11	15 18	The immersion of the first satellite by a 22 foot telescope, the sky serene and calm.
Sept. 2		10	43	57	The immersion of the second satellite with a 22 foot telescope, the sky serene and calm.
		6	13	11 24	The immersion of the first satellite by a 22 foot telescope; and <i>Jupiter</i> was not dis-

Anno N. S. True Time.

1727 N. S. True Time.

discover'd before, till the fatellite was now diminish'd.

1727	Sept. 9	13 ^h . 21'	35"	The immersion of the second fatellite by a 22 foot telescope, the sky serene.
	10	9	34 30	The emerfion of the third fatellite by a 22 foot telescope; the sky calm, but not every where serene.
	15	9	36 32	The immersion of the first fatellite by a 22 foot telescope, the sky serene and calm.
	Oct. 31	10	8 48	The immersion of the first fatellite by a 15 foot telescope; somewhat doubtful by reason of the wind, clouds and vicinity of the moon.
	Dec. 2	8	46 30	The emerfion of the first fatellite by a 22 foot telescope, exact: The weather very serene, notwithstanding the nearness of the fatellite and <i>Jupiter</i> .
		12	14 6 0	The emerfion of the third fatellite by a 22 foot telescope, the sky calm, but not entirely clear.
1728	Jan. 8	12	14 44	The emerfion of the second fatellite by a 15 foot telescope, certain only within a few seconds, because of the strength of the wind.
		12	33 34	The emerfion of the first fatellite by a 13 foot telescope within a few seconds, by reason of the same wind.
	10	5	58 7	The emerfion of the third fatellite by a 22 foot telescope, uncertain by a few seconds, by reason of the strong winds.
		7	0 12	The emerfion of the first fatellite by a 22 foot telescope; the winds were a hindrance.
	17	7	56 31	The immersion of the third fatellite by a 13 foot telescope.
		8	53 4	The emerfion of the first fatellite by a 22 foot telescope, exact.
		9	55 14	The emerfion of the third by a 22 foot telescope, good.
	Febr. 16	10	59 26	The emerfion of the first fatellite with a 22 foot telescope, within a few seconds.

Anno

Anno N. S. True Time.

1728	Feb. 13	5 ^h	28 ⁱ	20 ^u	The emerfion of the first fatellite with a 15 foot telescope, the fky ferene, but the <i>crepusculum</i> ftill bright.
	25	7	24	10	The emerfion of the first fatellite with a 22 foot telescope, the fky ferene.
	27	6	40	5	The emerfion of the fecond fatellite with a 22 foot telescope, the fky ferene and calm.
	29	8	0	29	The immerfion of the third fatellite by a 22 foot telescope, the fky ferene and calm; yet this obfervation is uncertain within 10 or 15 feconds, the fatellite difappearing and returning again for fome time.
	Mar. 10	11	18	19	The emerfion of the first fatellite by a 15 and 15 foot telescopes, the fky clear and calm.
	Apr. 12	8	16	12	The immerfion of the third fatellite by a 15 foot telescope, the fky ferene and calm.
		10	30	40	The emerfion of the third by a 15 foot telescope, the fky ferene and calm, and tho' <i>Jupiter</i> was not much elevated above the horizon, the obfervation is certain within a very few feconds.

Remarks on
thefe obferva-
tions.

The first obfervations were, till the month of *February*, 1727, made with a 15 and 20 foot and a half telescopes by my brother *de la Croyere* and myself. My brother very often employ'd *Campani's* 15 foot telescope but I another of 20 foot and a half, by means of which I obferv'd the immerfions of the first and fecond fatellites later by fix or feven feconds than my brother did by his tube. On the contrary, I fooner difcover'd the emerfions, entirely in the manner as we very often made trial of this in *France*, and as alfo appears from our obfervations of *August* 18, *September* 10, *December* 6, 1726, as alfo of *January* 7, 1727. There however alfo offer'd a difference of 12 feconds in the emerfion of the first fatellite *December* 29, 1726: Not to mention other differences ftill greater, to wit, of 21 feconds in the immerfion of the third fatellite *January* 2, 1727; but this laft difference is to be afcribed to the flownefs of the motion of this fatellite, as alfo to the circumftances of the time; which are mark'd on the fide of the obfervation.

After

After that my brother was sent to *Archangel* in *April* 1727, and had carried along with him the 20 foot and a half telescope, I in the other observations very frequently made use of a 22 foot tube, by means of which, as I had frequently found at *Paris*, I observ'd the immerfions of the first and second fatellites later by five or six seconds, than by the 20 foot and a half tube.

In these last observations I sometimes also made use of *Campani's* 15 foot telescope, and of another of 13 foot, made in *England*, and which exhibited the objects with great clearness: Nay very often the observations were made by these three different tubes of 13, 15 and 22 foot, being assisted therein, after the departure of my brother, by *M. Krafft* and *Vignon*: But as it did not always happen that the moments of observation were precisely at such an interval from each other, as the lengths of the tubes required, I thought that that was to be ascribed to the different make of the eyes; I therefore, thought it more adviseable to rehearse from all these observations such as I myself for the most part determin'd by the help of the longest of all our telescopes: And even from the very first, when my brother was still with me, we sometimes labour'd under this disadvantage, that for some days, especially in winter, the sun was not to be seen; which also was sufficient to cause some error in the time. Such observations, whose true time is uncertain from this very cause I have assign'd, are chiefly those of *October* 19, 28, 1727.

In the following times of the years 1727 and 1728 I was more certain of the true time, reducing oftner than at other times the motion of the clocks to the sun, namely as the occasion favour'd, that in the beginning of the spring of 1727 I might draw a meridian line according to my method in the *Memoirs of the Royal Academy of Sciences An.* 1719, p. 54.

Anno N. S. True Time.

1726 Aug. 9 12^h 59' 49" The immersion of the first fatellite observ'd at *Paris*.

14 51 30 The same observ'd at *Petersburg* by a 15 and 20 foot and a half tubes.

1 51 41 The difference of meridians.

But because the time at *Petersburg* at that time was not exact, but within a quarter of a minute, namely as the excessive *crepusculum* and other obstacles hinder'd, which remov'd the fatellite too soon from our view, the difference of meridians should thence come out somewhat greater: I shall, therefore, suppose it from this observation 1^h 51' 50".

16 14 55 4 The immersion of the first fatellite exactly observ'd at *Paris*.

Corresponding observations of Jupiter's fatellites in the Royal Observatory at Paris by Cassini and Maraldi with a 17 and 18 foot telescopes.
First observation.

The second observation.

Anno N. S. True Time.

I 18^h 28' 53"

The period of this fatellite by the tables.

1726 Aug. 18 9 23 57

The emerfion of the first fatellite as it should have appear'd at *Paris*.

II 15 49

The emerfion observ'd at *Petersburg*, taking the mean time between the 15 and 20 foot and a half telescopes.

I 51 52

The difference of meridians, which I take to be very near the truth, tho' in this place the vicinity of the moon was a hindrance to us. The fame also happen'd at *Paris*; therefore, the difference of meridians could not thereby be varied.

The third obser- 1726 Sept. 8 15 12 5
vation.

The immersion of the first fatellite observ'd at *Paris*.

I 18 29 10

The period of the first fatellite according to the tables.

IO 9 41 15

The immersion, as it should have been observ'd at *Paris*.

II 32 54

Observ'd at *Petersburg*, taking the mean between the times of the 15 and 20 foot and a half telescopes.

I 51 39

The difference of meridians.

The fourth obser- 1726 Oct. 19 10 29 53
vation.

The emerfion of the first fatellite observ'd at *Paris*, somewhat dubious.

12 21 46

The fame observ'd at *Petersburgh* by a 15 foot telescope.

I 51 53

The difference of meridians:

I have said in the preceeding notes to my observations, that I am not entirely certain about the true time of this observation: The fame at *Paris* is somewhat dubious, as the fatellite in both places was too near *Jupiter*, who was in opposition to the sun only six days before; yet as the difference of meridians does not thence come out too different from the preceeding, this observation is not to be reckon'd so faulty: Yet I shall take away three seconds, as this emerfion was observ'd at *Petersburgh* with a shorter tube than at *Paris*; so that by this observation the difference of meridians is 3^h 51' 50".

Anno

Anno N. S. True Time.

1726 Oct. 28 6^h 54' 35"
8 47 8

The emerfion of the first fatellite at *Paris*.

The fifth obser-
vation.

The same at *Petersburgh* by a 15 foot telef-
cope within a few feconds.

1 52 33

The difference of meridians, which ought to
be leffen'd by 3", on account of the diffe-
rent length of the tubes, and by fome more
ftill, by reason of the error which crept
into the obfervation at *Petersburgh*, and
which caus'd the emerfion to appear to me
later than the truth: But however this ob-
fervation may be treated, yet it produces a
difference of meridians no lefs than 1^h 52' 20",
which is much greater than any of the pre-
ceeding: But I take the principal error to arife
thence, namely that about this time we were
fome days without the fun, as I have already
obferv'd; wherefore, I think that this ob-
fervation is not to be regarded.

1726 Dec. 6 5 20 20
7 11 18

The emerfion of the first fatellite at *Paris*.

The sixth obser-
vation.

The same obferv'd at *Petersburgh* by a 20 foot
and a half telefcop, fomewhat dubious.

1 50 58

The difference of meridians, which increas'd
by 5", as the different lengths of the tubes
require, makes the difference 1^h 51' 3",
which is alfo to be rejected, becaufe our ob-
fervation was fomewhat dubious.

1727 Jan. 7 8 19 0

The emerfion of the fecond fatellite at *Paris*
obferv'd amidft fmall clouds.

The feventh ob-
fervation.

10 10 0

The same at *Petersburgh*, taking the mean be-
tween the tubes.

1 51 0

The difference of meridians, which, on account
of the clouds, doubtlefs, retarding the ob-
fervation at *Paris*, fhould be increas'd by
fome feconds: But as the quantity of this
retardation cannot be eftimated, this obfer-
vation alfo fhould not be admitted into a
decifive *computus*.

1727 Aug. 21 12 58 30

The immerfion of the first fatellite at *Paris*,
where, as the fatellite was entering the sha-
dow, it was loft by the wind fhaking the tube.

The eighth obser-
vation.

14 50 30

The same at *Petersburgh* by a 22 foot tube.

Anno N. S. True Time.

1^h 52' 0"

The difference of meridians, which should be diminish'd by seven or eight seconds, on account of the different length of the tubes, and by some seconds more, because of the agitation of the wind, which marr'd the *Parisian* tube, and remov'd the satellite too soon from the view: We may, therefore, suppose the difference to be 1^h 51' 50", not very different from the others.

The ninth observation. 1727 Aug. 30 11 15 18

The immersion of the first satellite observ'd at *Petersburgh* by a 22 foot tube, the sky clear and calm.

1 18 29 5

The period of this satellite according to the tables.

28 16 46 13

The immersion as it should have happen'd at *Petersburgh*.

14 54 7

The immersion observ'd at *Paris*, where the satellite escap'd the view, *Jupiter* falling in among thin small clouds.

1 52 6

The difference of meridians to be diminish'd by seven or eight seconds, as the preceeding, because of the different length of the tubes, and by some seconds more, on account of the small clouds that intercepted the view of *Jupiter* at *Paris*. Whence it will be pretty safe from this observation to suppose the difference of meridians 1^h 51' 50".

The difference of the meridians of *Paris* and *Petersburgh* with the longitude of *Petersburgh* from the first meridian passing thro' the island *Ferro*.

If now from the nine observations above delivered you take away the 5th, 6th, and 7th for the reasons there given, the mean between the other six will come out 1^h 51' 50", not much wide of the truth: Whence I scruple not to assume this difference of meridians of *Paris* and *Petersburgh* for the true difference, namely in time; for, a more exact cannot be had, unless by a greater number of uninterrupted observations at both places, otherwise than has happen'd in the few corresponding ones we have adduced. But by the observations made by F. *Feuillée* in the *Canary* islands, in the year 1724 and compar'd with those at *Paris*; the longitude of *Paris*, in respect of the most westerly part in the island of *Ferro*, which is itself the most westerly of the *Canaries*, was found precisely of 20°, exactly as my elder brother more than 20 years before had made it, as may be seen in the *Journal des Sçavans* Anno 1700: And which determination he always employ'd in constructing his geographical maps, notwithstanding the opposition of all other astronomers and geographers.

Con-

Converting, therefore, into degrees the difference of the times at *Paris* and at *Petersburgh*, found above, and adding 20 degrees, the true longitude of *Petersburgh* from the first meridian comes out in degrees $47^{\circ} 57' 30''$.

Anno N. S.

1726 Aug. 18 $11^h 15' 46''$ The immersion of the first satellite observ'd at *Petersburgh* by a 15 foot telescope, the sky clear and calm, and the moon and *Jupiter* near each other.

1 18 28 53. The period of this satellite at that time.

16 16 46 53 The immersion of the first satellite as it should appear at *Petersburgh*.

Observations of the eclipses of *Jupiter's* satellites corresponding to those at *Petersburgh* made at *Bononia* in Italy by *Manfredi*. The 1st observation.

1726 Aug. 16 15 29 0 The same observ'd at *Bononia* by a tube of 11 *Bononian* feet, or 13 *Parisian* feet; dubious.

1 17 53. The difference of meridians, which ought to be diminish'd by 3 seconds, because of the different length of the tubes: It will, therefore, be in round numbers $1^h 17' 50''$. But the *Bononian* observation was dubious: Whence also *Manfredi* has only set down the minutes.

Dec. 6 7 11 18 The emerfion of the first satellite at *Petersburgh* by a 20 foot and a half telescope; dubious. The 2d observation.

1 18 28 9 The period of this satellite at that time.

4 12 43 9 The emerfion, as it should appear at *Petersburgh*.

4 11 27 45 Observ'd at *Bononia* by a 13 foot tube; dubious.

1 15 24 The difference of meridians, which should be increas'd by about 10 seconds, because of the different length of the tubes; it will, therefore, come out $1^h 15' 34''$: But the observation at *Petersburgh* and *Bononia* was dubious.

29 7 15 48 The emerfion of the first satellite observ'd at *Petersburgh* with a tube of 15 foot, exact. The 3d observation.

5 59 26 The same observ'd at *Bononia* with a 13 foot tube.

1 16 22 The difference of meridians, to which must be added $3''$ on account of the different length of the tubes; the difference, therefore, will come out $1^h 16' 25''$, which seems to be exact,

it may come out $1^h 16' 30''$ within a few seconds, beyond which degree of exactness this observation at *Petersburgh* does not extend.

By the seven observations enumerated above, this difference was found as follows, to wit, By the 1st ——— $1^h 17' 50''$ The difference of meridians of *Petersburgh* and *Bononia* in Italy,

By the 2d ——— $1 15 34$

By the 3d ——— $1 16 25$

By the 4th ——— $1 15 55$

By the 5th ——— $1 15 39$

By the 6th ——— $1 15 55$

By the 7th ——— $1 16 30$

From which, if the 1st be taken away as differing too much from the rest, and the mean between the other 6 be taken, we shall have the difference of these meridians $1^h 16' 0''$, which is to be receiv'd till exacter observations can be had in both places.

Anno. N. S.

1726 Aug. 9. $14^h 51' 30''$ The immersion of the first satellite observ'd at *Petersburgh* with a 20 foot and a half telescope, dubious by $15''$, because of the *crepusculum*.

12 13 30 The same at *Lisbon*.

2 38 0 The difference of meridians, which may be increas'd by some seconds, because of the clearness of the *crepusculum*, which at *Petersburgh*, doubtless, remov'd the satellite too soon from the view: I may, therefore, suppose from this observation $2^h 38' 10''$.

Sept. 10 11 32 56 The immersion of the first satelite observ'd at *Petersburgh* by a tube of 20 foot and a half.

8 54 54 The same at *Lisbon*.

2 38 2 The difference of meridians, undoubtedly very near the truth, since nothing can be excepted against both observations, and this difference likewise almost agrees with the preceeding.

Oct. 28 8 47 8 The emerision of the first satelite observ'd at *Petersburgh* by a 15 foot tube within a few seconds.

6 8 52 The same at *Lisbon*.

2 38 16 The difference of meridians, to be diminish'd $7''$, on account of the different length of the tubes;

tubes; this difference will therefore be 2
38' 9" correct.

It was found by the 1st observation	2 ^h	38'	10"
By the 2d —————	2	38	2
By the 3d —————	2	38	9
Of which the mean is —————	2	38	7

A remark on
these observations
wherein is de-
duced almost the
whole extent of
Europe in longi-
tude.

The above recited observations made at *Lisbon* and corresponding with those at *Petersburgh*, are, perhaps, the first that ever were made in *Europe* with any exactness at so great a distance: As, therefore, *Lisbon* is the most westerly city of all *Europe*, and as hitherto there have been no other accurate observations made in *Russia* (the most easterly part of *Europe*) besides those made at *Petersburgh*, the preceeding difference of meridians of *Lisbon* and *Petersburgh* may be reckon'd as the greatest extent of *Europe* in longitude, so far as could hitherto be accurately determin'd by immediate observations: The above difference of meridians, converted into degrees of a circle, becomes 39° 31' 45".

Of the true measure of a Copenhagen Foot and Ell, the magnetic Variation, and of the Longitude and Latitude of Copenhagen, &c. By Erasmus Bartholin. From the Acta Hafniensia. Tom. I. An. 1671, 1672. p. 215.

Translated from the LATIN.

The measure of
the Copenhagen
foot.

I Observe that such as have carefully set down the measures of different nations, have not been sufficiently inform'd as to those of *Denmark*; for, *Snellius*, in his *Eratosthenes Batevus*, has made the *Copenhagen* foot of 934 such parts as the *Leyden* or *Rhinland* foot is 1000. But as he confounds the *Copenhagen* with the *Bremen* foot, I suspect, that those, who transmitted this measure to *Snellius*, took the measure of that foot, which probably the *Bremen* merchants us'd then at *Copenhagen*; for, it appears, that those of *Bremen* formerly had a mart at *Copenhagen* (where now is the royal arsenal) and which in *Danish* is call'd *Bremerholm*, doubtless, taking its name from the merchants of that country living there. When we of *Denmark* have occasion to employ the *Copenhagen* foot, we use half an ell, the standard whereof made of iron is affix'd to the door of the Guildhall at *Copenhagen*; yet I found it by no means to agree with that proportion publish'd by *Snellius*; for, applying myself to investigate that measure, I found that the *Copenhagen* ell was of 2008 such parts, as the *Rhinland* foot is 1000; and consequently, that the *Copenhagen* foot or half ell is 1004, and also that the cube root of the *Copenhagen* gallon is 0,392: But as the preceeding year, viz. 1671, M. *Picart* carried along with him a very exact measure of the

the *Paris* foot, to the end that he might compare the measures of different nations with his own; we tried what proportion the *Copenhagen* ell might have to the *Paris* foot, and making this last of 1440 parts, as also the *Leyden* foot of 1390, the exact proportion of the *Paris* toise to 3 *Copenhagen* ells was found as 720 to 701: But let posterity observe, that we here make mention of the *Copenhagen* ell according to the standard at this day; for, probably it may be different from the ancient, as the old standard of the *Copenhagen* ell was some years since lost in the siege of the city: Whence there might easily creep a mistake into the new one, and its divisions. But as to the measure of the present ell there is no scruple; and the curious in measures may safely use the proportion above-mention'd.

It is now commonly thought, that the magnetic declination is subject to a more perplex'd motion, and that in the same places it sometimes inclines to the east and sometimes to the west. Authors testify, that they have found this by several experiments, and in 1649 I find, that at *Copenhagen* the needle varied 1 degree and a half to the east, according to *Hermann Luchtemacher*, the king's compass-maker at that time. But as the unwary especially may be easily deceiv'd by a fallacious observation, we thought proper to make trial of this matter in the garden adjoining to my house with a very exact needle, which the above-mention'd *Picart* brought with him; and by this observation we found, that it declin'd from the north to the west 3 degrees 35 minutes. In the island of *Huen* the declination by the same needle shew'd to our surprize 2 degrees 35 minutes; a difference of a whole degree in 3 miles distance.

The magnetic variation at *Copenhagen*.

The illustrious *Christianus Severini Longomontanus* had formerly deduced from his observations the elevation of the pole at *Copenhagen* $55^{\circ} 43'$, with which we were hitherto satisfied, as being very agreeable to the truth, till with exacter instruments in our *Observatory* we could define it with more certainty; and tho' the observations were made with a larger sextant and which is still extant, and tho' there is no doubt to be made of the fidelity and industry of so experienc'd a person; yet as the divisions of the limb do not come up to the perfection of *Tycho*'s instruments, we may justly hope for more accurate observations for establishing the latitude of this place. *Riccioli* from his observation of the sun's parallax concludes, that this elevation is too little, and he thinks that 55 degr. 45 min. are more agreeable to the truth. We made trial of this matter along with M. *Picart*, with very exquisite instruments brought from *Paris*, being the very same with which he had before discover'd in *France* the quantity of a degree of a great circle in miles: But we observ'd it rather greater by 1 minute and a half than too little. From these very accurate observations, therefore, we have the exact elevation of the pole, or the latitude of *Copenhagen*, 55 degr. 43 min. 30 sec.

The latitude of *Copenhagen*.

The longitude of
Copenhagen.

That we might with certainty define the longitude of *Copenhagen*, or the difference of meridians between our *Observatory* and *Uraniburg*, on account of the advantage we hope to reap from the observations of *Tycho*, it was no difficult matter in so small a distance to attempt the thing in different ways; and we principally employ'd surveying, taking a very long base, of a certain determinate number of toises, in the island of *Huen*, and often repeating the observation to avoid any sensible error; and then it appear'd, that the distance between the *Observatory* and

<i>Helsingor</i>	_____	20242	} <i>Paris toises.</i>
<i>Uraniburg</i>	_____	13494	
<i>Landscron</i>	_____	13651	
<i>Lunden</i>	_____	19937	
<i>Malmoe</i>	_____	14420	

Observers were also sent into the island of *Huen*, under the direction of *Olaus Romer*, with a very correct clock, telescopes, and an astronomical quadrant, in order to observe the eclipses of *Jupiter's* satellites, while we in the *Observatory* applied ourselves to the same thing: And lastly, we often us'd burning torches in that window of the *Observatory* which looks towards the island of *Huen*, which torches at certain intervals of time we hid again, and to those in the island they exhibited a sight not unlike the eclipses of *Jupiter's* satellites; for, we charg'd them accurately to observe the times of occultation, either by the eye or by the telescope: And by these experiments we found, that the *Observatory* at *Copenhagen* is 29 seconds of time more westerly than *Uraniburg*.

The determination of a meridian line in the *Observatory* at *Copenhagen*.

It will not be foreign to treat of this matter, as there is some suspicion about the variation of the meridian line. I had the preceeding year, along with *M. Picart*, pass'd over into the island of *Huen*, in order to discover the traces of the castle of *Uraniburg*, and to observe the place where for so many years astronomical observations were made. It would have been a difficult matter for us exactly to determine the place itself, had I not had the observations of the angles of position in one of the volumes of observations, formerly set down by *Tycho* himself, with a design of drawing a true meridian line there; and then we were all greatly surpriz'd at the difference between them, and those set down in the second volume of observations, and carefully repeated several times; nor were we ignorant of the errors arising from the observations themselves, or the diversity which may be caus'd from the variety of the instruments employ'd; for, the line of aim is more certain by telescopic than by common sights. But so considerable errors, as we had discover'd, seem incompatible with the extraordinary industry of *Tycho* in a no difficult observation, and which is the basis of the rest: Wherefore, tho' our *Observatory* may some time or other feel the calamities of time, yet from the following observations posterity may judge, whether the meridian line is subject to variation.

Helsingor

	Degr.	Min.	Sec.	
<i>Helsingor</i> ——— ——— ———	3	26	40	N. E.
The right side of the turret of the church in <i>Huen</i> , by <i>Tycho</i> }	13	52	40	N. E.
The place of <i>Uraniburg</i> mark'd by us ——— ——— ——— }	16	40	0	N. E.
The middle between the two turrets of <i>Lunden</i> ——— }	86	1	0	N. E.
<i>Malmoe</i> ——— ——— ———	73	3	10	S. E.
The middle between the two turrets of <i>Rotſchild</i> ——— }	82	21	15	S. W.

The angles of position observ'd from the middle of the Observatory at Copenhagen, An. 1672. with an iron quadrant and telescopic sights.

Aug. 24. In the morning the spot was first observ'd in the sun's eastern limb. A solar spot observ'd An. 1671.

Aug. 29. The same spot, which appear'd to consist of three bodies, was in the meridian after the sun's centre 15 seconds of time, and was 1 min. 40 sec. more southerly than the same centre.

Sept. 1. The spot in the meridian preceded the sun's centre 10 sec. of time, and was 1 min. 25 sec. more northerly.

Sept. 2. In the morning it preceded the sun's centre 33 sec. of time, and was 4 min. 50 sec. more northerly.

Sept. 6. In the morning the spot was no longer seen.

March 12. About 9 in the evening the comet was observ'd below *Medusa's* head; the head of the comet appear'd small, uniform'd, and but little luminous; the tail was broader, but scarce a degree in length; it was distant from *Medusa's* head 5 degr. 50 min. and from *Andromeda's* foot 10 degr. 30 min. A comet observ'd at Copenhagen in 1672.

Mar. 13. About 8^h 20' in the evening it was distant from *Medusa's* head 5 degr. 32 min. and from *Andromeda's* foot 12 degr. 25 min.

Mar. 16. At 8^h and a half in the evening, the comet was seen (in the manner represented by the Fig.) between two stars, which are not found in the catalogue of stars. Fig. 12. Pl. IV.

Mar. 17. At 8^h and a half in the evening, the comet was distant from the south foot of *Perseus* 4 degr. 23 min. 20 sec. and from *Perseus's* knee 8 degr. 32 min. 30 sec.

Of the Coral-Fishery, &c. From the Breslaw Collection. December 1717. Class IV. Art. IV. p. 430.

Translated from the HIGH-DUTCH.

IT is well known of coral, that, besides its medicinal use, it is commonly employ'd, and that chiefly as an ornament, and partly also on a religious account in rosaries; and for the most part with us in toys (which are the manner of fishing for coral.

the most usual ornaments of the common people, whence consequently, there is a great consumption of it) yet, according to its different degrees of bigness and beauty, coral gives a different price; tho' generally among all other precious things it is the cheapest: Whereas in *Asia*, on the contrary, its value is much higher, and it is esteem'd among them as much as pearls among us^a. So that this great consumption of coral would seem to require its being very plentiful; and yet it is found no where but in one particular tract, namely, in the *Mediterranean* and *Tuscan* sea about *Majorca*, *Corfica*, *Sardinia*, and *Sicily*, as also near *Catalonia*, and on the *African* coast, *Tabarco*. Here the coral-shrubs, growing on the rocks at the bottom of the sea, are fish'd for from *April* till the close of *July*; and this fishery is carried on with upwards of 200 small vessels, which are built at *Genoa*, and are very light and carry a large sail, and run so swift that a ship cannot easily come up with them. Each of them is mann'd with seven hands and a boy: Upon this they proceed to the coast where the coral is to be found. They join together two large beams crosswise, and in the middle fix a large piece of lead for the timbers to sink. These cross-beams are wound round with several coarse, loose-twisted, and rough ropes that hang down; and, by means of a rope that hangs with one end at the forepart, and with the other at the hinder part of the ship, they are let down into the sea. Now as the ship sails along the rocks, and drags the cross-beams after it, the coral-twigs are entangl'd in the locks of the ropes; and in this manner they are hal'd up with the beams; but to this more than one ship is commonly necessary, and yet there always falls into the sea more of the coral than is taken up; then it is clear'd of the slime and rind, and by the turners form'd into coral, with which they carry on a great trade far and near, particularly in *Italy*, and more especially at *Genoa* and *Leghorn*^b.

Different sorts of
Exquisite coral.

Several people have shewn different methods of making coral by means of art; partly with fine shavings of harts-horn, dissolv'd in a *lixivium* of the ashes of the ash-tree and with cinnabar; and partly with *calx* of plaister of *Paris*, *minium* and cinnabar, by means of the whites of eggs and a calx-lee and wine; partly with harts-horn, plaister, fragant, gum-arabic and cinnabar; partly with ox-horn shavings, dissolv'd in a strong lee, and afterwards boil'd and with cinnabar, and partly in another manner: And that its colour may be the darker, some use *sanguis draconis*, *hæmatites*, saunders, &c^c. Whereas, on the contrary, the turners at *Nuremberg* are masters of a more simple contrivance of making bones red, in such manner that the balls turn'd of them may deceive a great many people: Nay

Anselm

^a *Tavernier Voyag. lib. II. c. 28.*

^b *Vid. Asiat. und African. Denckwürdigk p. 316. — Kunckel's glass-macher-Kun p. 457. — La Sardaigne Paranymphe p. 9. — Marperger Kauffmann's Magazine p. 339 seq. besides many others. Valentin. Musæum Musæorum p. 104.*

^c *Vid. Gansii histor. Corall. cap. 10. p. 116, seq.*

Anselm. Boetius de Boot^d shows how to imitate entire branches and shrubs of coral by means of sticks of old wild pear-tree, and a paste of cinnabar, colophony and wax. And *Cnæffeliuſe*^e was master of the like secret. Yet all these cheats are by several methods very easily discover'd. We have lately seen another factitious sort of coral, entirely different from the above counterfeits, in regard that this artificial coral was exactly of the colour of true coral, and not of a bright red, but almost of a purple or blood-colour, entirely smooth and hard, and neither heavier nor lighter than other coral. Upon scraping it with a knife it yielded a flesh-colour powder, exactly like the true coral. The surface of this coral was, it is true, by this means white, but by gently wetting it, it immediately became red again, and the whole substance thereof was throughout of a like redness. It made as strong an effervescence with spirit of nitre as true coral does, and yielded a yellowish *magma*, as well as that other, and in biting it, it imparted to the teeth as grating a sensation as the genuine coral: And yet for all this it was not the less counterfeit; as partly appear'd by its internal substance, which sparkled throughout like small crystals, and also shewed a texture as gritty as marble, and consisting of the like small *moleculæ* with it; partly as it was not so hard as the genuine coral; partly as it yielded no sharp *calx* by calcination, as the true coral does, which indeed lost its colour and only became a little softer, as all calcin'd stones do, but did not change its taste; yet there was found this difference, namely that as the genuine coral with spirit of vitriol tastes entirely vitriolic, as M. *Lemery* remarks in *l'Hist. de l'Acad. Royale des Scienc. An. 1711*; this factitious coral had no such taste. And we are of opinion, that this matter is nothing other than a sort of red marble, such as is found in great plenty in the mines at *Annaberg*, at *Hildesheim*, in *Bohemia*, and in other parts^f.

A new kind of Lamp. By Joh. Christophorus Sturmius. From the Acta Eruditorum Lips. An. 1683. p. 304.

Translated from the LATIN.

THIS new kind of lamp consists of two parts; one, the lamp itself A, with its nose B, made after the common manner for receiving the wick; the other, a small vessel C, for gradually pouring out the oil into the lamp; and which at the same time serves for a cover: It is close above, and below at the bottom it is pierced with several holes; in the middle of its bottom is solder'd a somewhat wider pipe EDF, so as not to reach the upper parts of the vessel about E, and about F to enter about a quar-

Description of
this lamp.
Fig. 13. Pl. IV.
Fig. 14.

^d Gemmar & lapid. histor. lib. II. cap. 156. p. 159.

^e Misc. Nat. Cur. Dec. I. An. 6. & 7. app. p. 67.

^f Vid. Albini & Weissn. Berg. chron. tit. 21. p. 163. Agricola de nat. fossil lib. VII. c. 4. p. 627. Kentmann. Nomenclat. rerum fossil tit. Marmora p. 54.

a quarter of an inch within the cover of the lamp, which has 4 large holes; and the orifice of the pipe is to be exactly in a level with the cover and parallel thereto; through this orifice F, upon inverting the vessel, the oil is pour'd in without any great precaution; and when it is fill'd, and the orifice F stopp'd with the finger, it again returns into its proper situation, and upon removing the finger below, it is nimbly put on the lamp and fasten'd by its hooks, affixt to the cover, so as to appear in the form represented by

Fig. 15. Pl. IV.

Fig. 15. In this construction of a lamp, which I believe is less operose than any other, the following things happen.

Observations
thereon.

Fig. 14.

1. No oil runs out thro' the holes of the bottom D, as long as the lower orifice is stopp'd by the finger and the external air excluded.

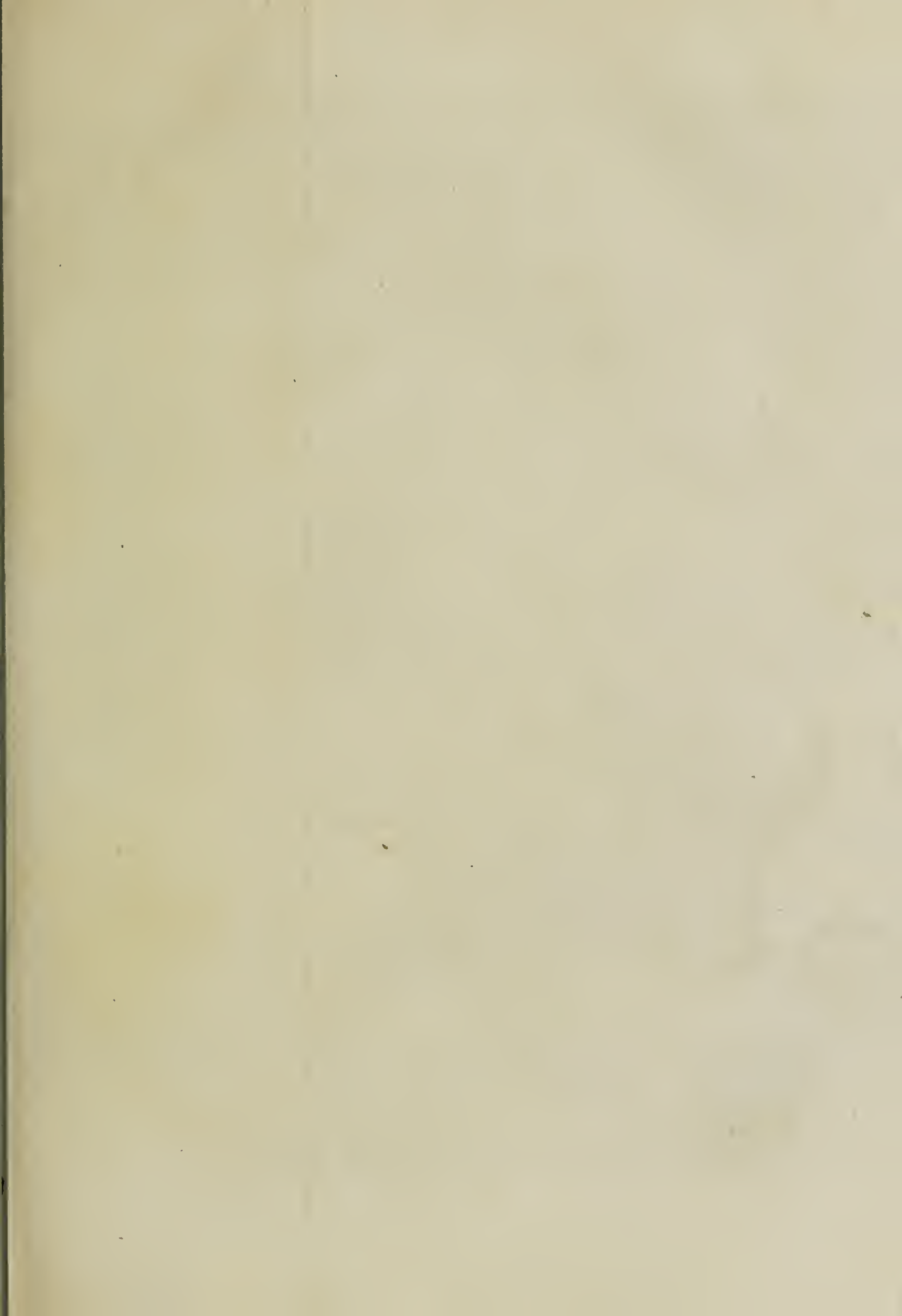
2. But upon removing the finger (which ought not to be done before the cover is just near put on the lamp) the oil, forced in small threads thro' the holes of the bottom by the ingress of the air thro' the pipe E F, is collected through the larger apertures of the cover into the internal cavity of the lamp, till with its uppermost surface it touches the orifice of the pipe F: But then

3. That the air, moreover, may not enter and force itself into the vessel through the tube now clos'd by the oil, the flux of the oil is stopp'd, which is afterwards to be gradually consum'd by the burning of the wick in B.

4. But if the oil is consum'd so much, that its uppermost surface does no longer reach the lower orifice F of the pipe, the air, having free access thro' the holes of the cover, suddenly insinuates into the open tube, and tending upwards forces out again as much oil as is again sufficient to stop up the pipe below: And this afterwards happens alternately so long, till the vessel C is exhausted: But this vessel may be commodiously taken off the lamp by undoing the hooks of the cover, be again fill'd, and at length put on again, the flame of the lamp in the mean while being neither extinguish'd, nor in any sort disorder'd thereby.

5. But in regard I have learn'd by experience, that on account of the almost insensible consumption of the oil, only a very small portion of air is admitted at each time, and few drops of oil are forced out thereby, I found that a great number of small holes in the bottom were not so necessary, but that three or four narrow pipes, exactly answering to the holes of the cover, might suffice; in which case a smaller and more managable capacity of the lower lamp would abundantly answer, and we should have the less reason to be afraid of dirt, and the upper vessel (which may be commodiously made of glass, and nicely folder'd to the metalline rim D E, that the want of oil therein may be the more easily observ'd by the eye) might be of any bigness at pleasure, so as to suffice to feed the lamp for some months successively.

Fig. 16.



Let L.

Fig. 1. p. 117.

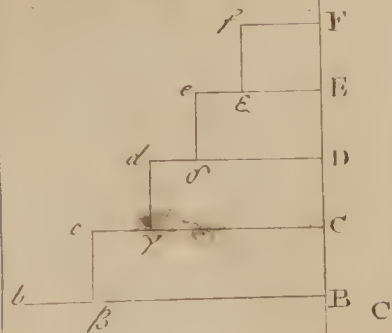


Fig. 2. p. 182.

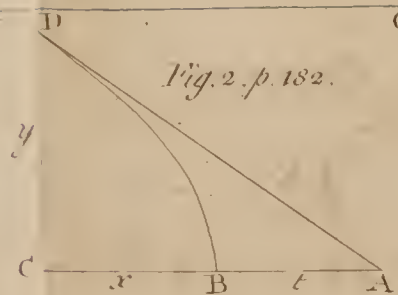


Fig. 3. p. 183.

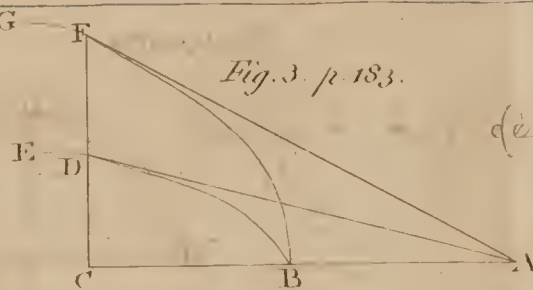


Fig. 4. p. 189.

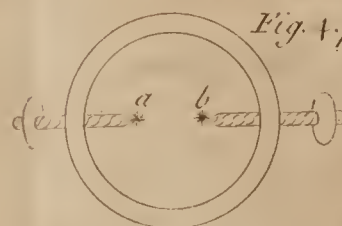


Fig. 5. p. 195.

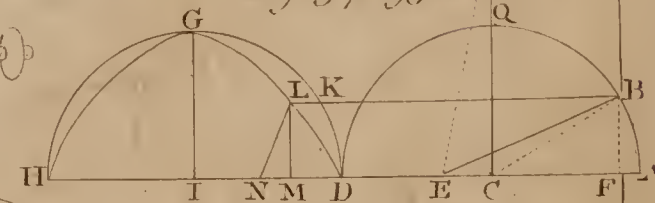


Fig. 9. p. 225.

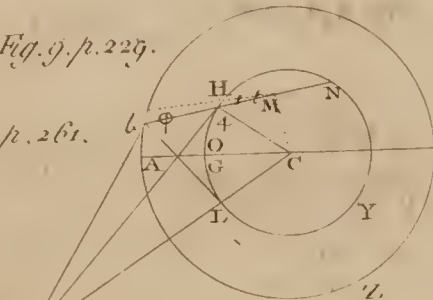


Fig. 14. p. 261.

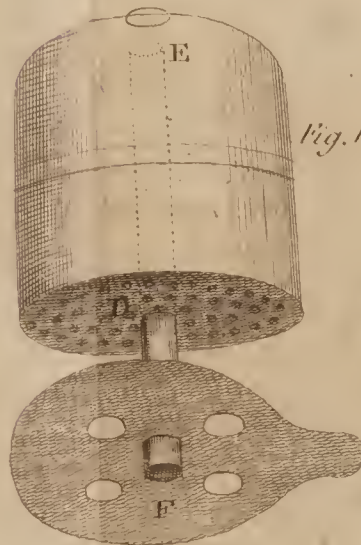


Fig. 13. p. 261.

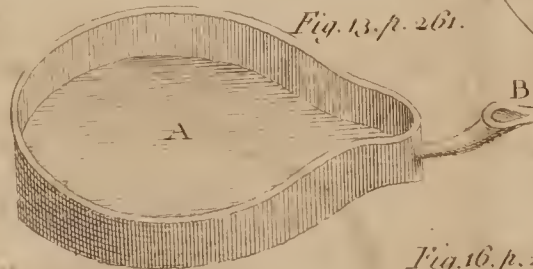


Fig. 16. p. 262.

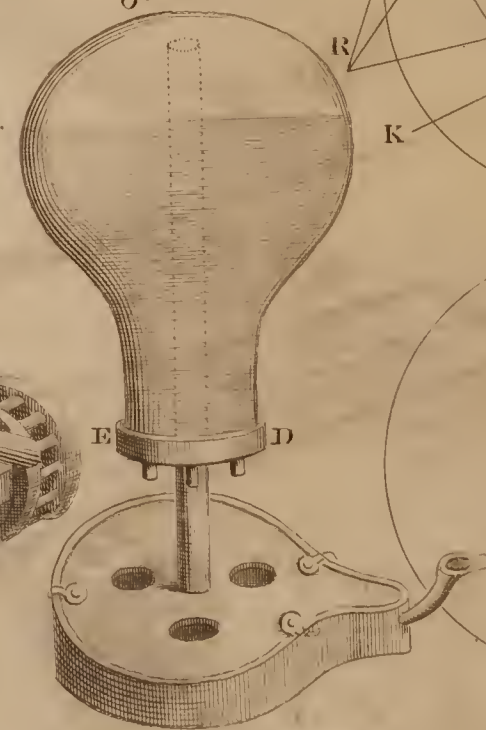


Fig. 6. p. 197.

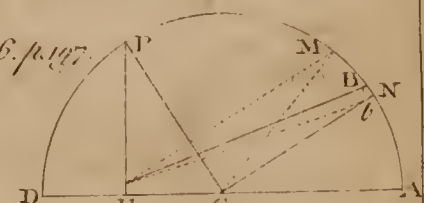


Fig. 10. p. 230.

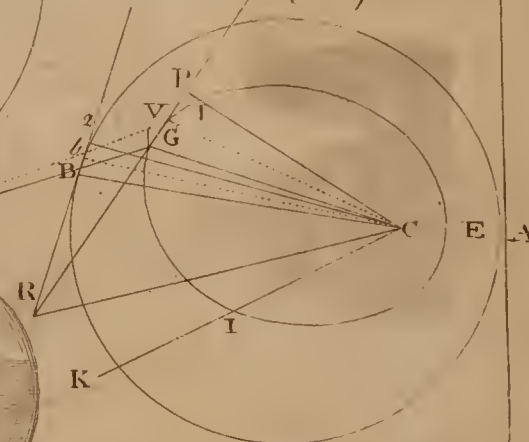


Fig. 11. p. 231.

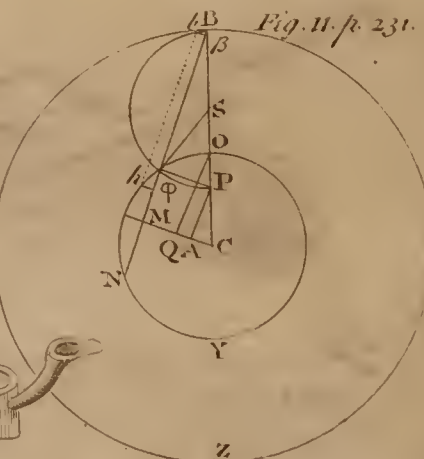


Fig. 12. p. 250.



Fig. 15. p. 262.

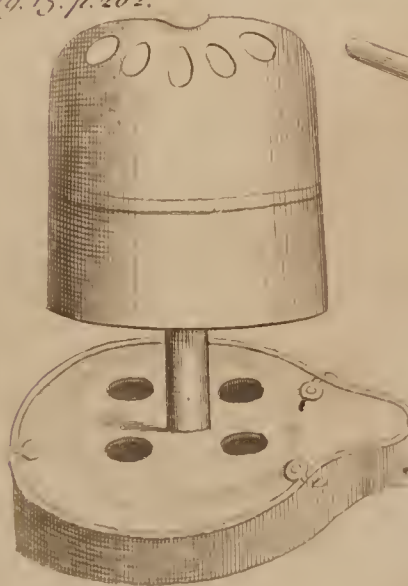
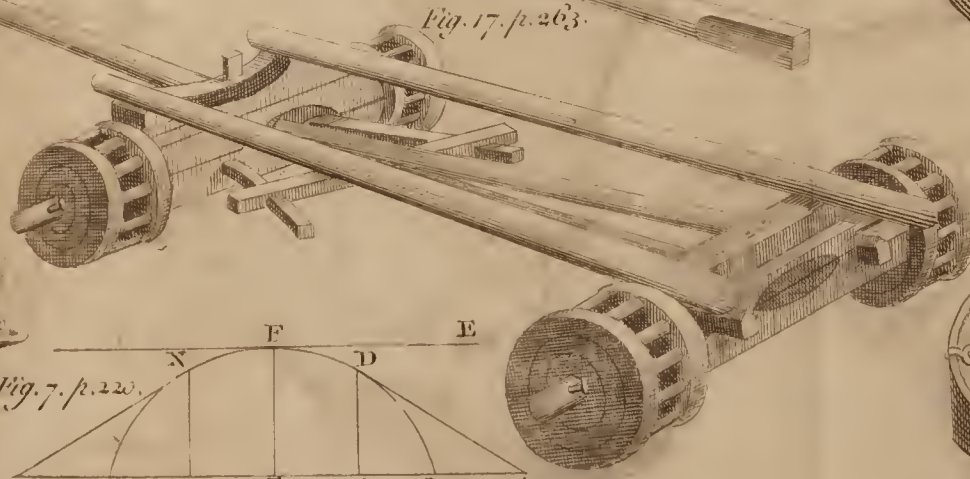


Fig. 7. p. 220.



Fig. 17. p. 263.



Smith delin.

Willet sculp.

Of a new and easy sort of Wheel-carriage for great Loads. From the Breslaw Collection, Nov. 1717. Class V. Art. IV. p. 360.

Translated from the HIGH-DUTCH.

THIS machine consists of a wheel-carriage, which is otherwise of a common structure except as to the wheels, whereby the greatest loads may be carried by a very small or easy impulse. The first invention of this machine was owing to the ingenious mathematician, *Hartmann*, who made use of it at *Gotha* for carrying a very heavy statue, and by it, by means of four men, the statue was brought with all imaginable ease to the desired place, which otherwise would be difficult to effect with a great number of horses. As soon as we were inform'd of this invention, we caus'd make a model of the machine; and we found in fact, that two of the strongest men, and of a pretty good weight standing on it, might by means of two levers, be carried along by a single man, nay by a child, and that very commodiously and without any straining. And as in the presence of a great personage about 20 hundred weight were carried along by four boys, so it is probable, that upwards of 80 hundred weight might be driven along by four strong men. The whole mechanism of this machine depends on the wheels, as the rest of this sort of carriage, may, according to the uses it is design'd for, be accordingly fram'd. These wheels consist of a pair of trucks, which at the rims are fastened to each other with cross-staves, yet so that these staves stand pretty near each other, and require no greater opening between them than what may receive the lever. Each wheel, when the load is great, requires one man; and these four men together, can by means of levers stuck into the interstices of the staves, and whereby the wheels are mov'd, drive the carriage with the load backwards and forwards; and by a fifth person the machine may be directed and turn'd; and this is done with much greater ease and advantage than is possible by means of horses; in regard a greater number of these is requisite, and even then they cannot be made to draw equally; and besides, they require more room, which in crooked and narrow places is not always to be had. It is true, that by this machine the carriage is more tedious than by horses, and it likewise has some disadvantages in clayey bottoms and deep roads, tho' it is not to be denied, but that in hilly, crooked and other impassable places, as also in arsenals, large buildings, stone-bridges, it may be us'd for carrying along large statues, &c. with much greater commodiousness and advantage than by horses, especially if one applied himself to bring this machine to greater perfection by some additional improvements.

Description of
this machine.
Pl. IV. Fig. 1.

Of the nature of Amber, and Experiments thereon. From the Acta Haffniensia, Tom. I. An. 1671 and 1672, p. 110.

Translated from the LATIN.

Of the nature of
amber.

FROM the new pits of *Copenhagen* were dug several pieces of amber of various sizes. We are to observe, that the diggers remark, that wherever they find amber, they there find along with it its *matrix*, to wit, the barks of the oak, near which it does not only lie, but firmly adhere to them, as may be plainly seen in various pieces. There is also another mineral body, to wit, a black, and as it were, burnt wood, to which the amber also adheres; yet I could readily take it for some *bitumen* or other, or for a black amber, did not its smell, which in burning is disagreeable, dissuade me from this opinion; and that it is rather to be taken for the remains of that burnt wood; yet *Camden* in his description of *Whitby* relates, that such black amber or agate is also to be found in *Britain*: And we have seen it dug out of the pits of *Copenhagen*. Whatever it be, it is no easy matter to determine, whether amber grows in these mineral bodies, or whether by the washing of the *Baltic* sea, to which formerly a great part of *Copenhagen* lay expos'd, it be driven hither from other countries, where either oaks or other resinous trees transude this matter. We remember, that sometimes in the inland hills of *Zeeland* were found pieces of it; and not long since a piece of amber of the bigness of a man's head was thrown up by the plough in the farm of *Tygestrup*. But as no part of the island is free of the adjoining sea, so our diggers have observ'd, that they find no amber in the city pits, before they come to a bottom answering to the depth of the sea. That all amber was originally soft appears from various experiments; 1. *Andreas Aurifaber* saw a flexile and soft piece managable like wax: and there is such a piece in *Wormius'* possession. 2. In some pieces there floats a liquor or fluid drop; and such a piece I lately saw with *Ivarus Scholerus*. Upon raising the amber upwards the drop moves and puts on in three places, first a globular figure, and then in its progress an oblong form, and at last becomes plain, which, doubtless, is owing to the figure of the containing place. What this liquor is, is no easy matter to determine: It may, probably, be petrol, kept here uncorrupted for ages; for, the same *Scholerus* shew'd another piece, which, but gently touch'd with the finger, would yield the scent of petrol. *Daniel Hermann* in his *Discursus philosophicus de Succino Prussiano*, suspects, that he observ'd water floating in a like piece, and increasing with the moon, and without any waste thereof; and he wonders, why the water is not dried up, whether the amber preserves it uncorrupted, or that it is not common water; and that this last is true appears from that piece of *Scholerus'*, because the liquor ascends like spirit and oil; nor could

could it be included air, which must have escap'd long before. 3. Many insects, *animalcula*, and other things are seen in amber, which were entangl'd in its formerly soft substance, as in a glue, and were harden'd in that position of the body wherein they were entangl'd. As to flies, gnats, spiders, straws, &c. it is a thing commonly known. The above *Scholerus* has one piece of amber, wherein an entire cricket floats extended, and another piece, wherein two gnats are observ'd *in coitu*. *Job. Wigandus*, in *Histor. Succin. Boruss.* relates, that *Jo. Gobelius* had a piece of amber, in which was seen, as if alive, a green frog, which usually sits on the leaves of trees. And *Dan. Hermann* relates, that a lizzard was found in amber: And *Frederic the Third*, king of *Denmark*, had such a piece. *Andr. Aurifaber*, *cap. 1.* has related, that fishes and their spawn are involv'd in amber. And that we may not doubt of its vegetable origin, a cone of firr has been observ'd in a piece of amber, of which *Scholerus* made a present to *Picart*. 4. A plain proof of this is a piece of soft amber thrown into the sea, wherein was included a paper, on which was mark'd the year it was done, that posterity might learn, whether that soft piece of amber would, in tract of time, undergo any change. In an age after, the same piece thrown out by the sea, was solid and hard, with its included paper: And hence it appear'd to the curious, that it ow'd its hardness to the salt of the sea; and this I was told by *Hen. Crentzfeldius* from a disputation of *Andreas Concius*, professor of mathematics at *Konigsberg*, *Anno 1660*. We, therefore, doubt not but it was a liquid rosin, or the tears of a tree, concreted and harden'd by the salt of the sea, or by length of time on the sea-shore; tho' others from probable reasoning suspect, that it is compacted into this solid form from a fatty *bitumen*.

The generation of amber will be illustrated by its analysis. Naturalists doubt not, but that it may be dissolv'd again, and after dissolution be coagulated, or made into a solid mass; they keep the method of doing this as a secret, tho' *Anshelmus Boetius*^a enigmatically discloses it, and proposes it to be divin'd by a true naturalist. I have tried several experiments along with *J. Gothofredus Becker*, an ingenious apothecary, which I shall briefly relate, and thereby give a handle to others farther to investigate these mysteries of nature.

Experiments on
amber.

1. Amber, being grossly pounded and put into hot wax, could not be observ'd to become soft; that indeed it united with the wax, but by the taste discover'd its roughness.

2. We tried the same with rosin of firr, as being of affinity with it; but the mass coagulated from it, by its unequal appearance, frustrated our hopes.

3. Infusing it in oil of spick, in petrol, and in oil of turpentine, it did not suffer itself to be entirely dissolv'd, but by the taste it discovered some grittiness.

4. The experiment succeeded in distill'd oil of lavender ; for, by a gentle heat in a glass the amber was, as it were, resolv'd sensibly into a mother of oil, which by the taste was entirely equal and soft ; other distill'd oils will produce a like effect, as also rectified spirits of wine : Whence an excellent remedy is got from amber, impregnated with its own oils.

5. It runs with a vehement flame, but it loses its brightness ; it becomes brittle, if coagulated, like a rosin.

6. To make it again concrete and harden, there is an easy method by evaporating the distill'd oil.

7. In a close and well luted crucible, with a moderate fire, the dust of amber does, like a glebe, collect into a ball, but it is easily beat small ; in a strong fire it melts and being harden'd, it adheres to the sides, with the smell of burning amber, tho' it collects by heat alone, without a flame.

8. Oil of amber is not coagulated by pouring spirit of salt to it, as some give out, but the oil floats a-top, and does not mix with it.

9. It is well known to such who use amber in lac-works, that in lintseed oil it may be boil'd to a liquid consistence ; I doubt not, but it may be dissolv'd and coagulated, by other methods, as a *Dutchman* at the exchange at *Copenhagen*, knows how to dissolve pieces of crystal, and blow them into new elegant glasses.

Olaus Borrickus, communicated to me an elegant experiment, tried by him some years ago : He committed petrol to a gentle heat in an alembic for three weeks, after which, with a stronger fire, he forced out its oleaginous humidity, and by repeated distillation, he abstracted the remaining liquor, if there was any, whereby there was left behind a solid body, harden'd by the fire, and emulating amber both in brightness and electricity ; yet this mass was more brittle than true amber.

An Account of Tea and the manner of preparing it, &c. From the Breslaw Collection, December, 1717. Class V. Artic. I. p. 443.

Translated from the HIGH-DUTCH.

Tea and the several sorts thereof

THE tree that yields the tea has a stem from top to bottom, furnish'd with many branches ; the wood thereof is very hard, firm, and provided with a thin brown rind ; the leaves, both in size and other respects, come nearest to those of the four cherry, and when fresh, they are without any smell ; but in harvest the blossoms grow upon short stalks behind the leaves of the tree, and consist of six white small blades, which smell disagreeably and taste bitter ; from which there comes a fruit not unlike the pods of the *American Palma Christi* : So that one, two, nay three of them, as big as floes, hang together on one stalk, whose outmost husk bursts at last, and out of it falls a small round nut with a thin shell, not unlike a chesnut, whose kernel, like a hazel-nut, is again encompass'd

with

with a brown downy substance; but the kernel itself is white, first of a sweetish and then of an oily, disagreeable taste, which together with the flowers is of no service to the inhabitants. As to the planting of these trees, they are propagated by the seed; so that, particularly in *Japan*, they set them in furrows and ridges of the fields, but not nigh each other, that they may not cast too large a shade, and prove prejudicial to other plants. The seed itself, before it falls out of the outmost husk, is set in the earth from one to one and a half foot depth, so that at least there are put from 6 to 12 nuts in one place, as commonly not the fourth or fifth of them is wont to come up. After they come up, the young trees are laid round with horse-dung and thus manur'd, and this is repeated yearly by good planters. After three years they begin to pick off the leaves below for the first time, and that pretty plentifully, which gives the best tea. In 8 or 10 years they attain to the ordinary bigness of a man, at which time, as in proportion they send forth few and consequently hard leaves, they are again cut down, which is the reason that a great number of new suckers spring from the root, which yield more leaves than the tree did before. The first crop happens before the vernal equinox, and is gather'd by a peculiar number of hands, and tho' in this crop the smallest leaves are obtain'd, yet they are, as being young, and for the most part not quite spread out, the best and most valuable tea, and is only us'd by great and rich people; wherefore in *Japan* it is call'd *Imperial* tea, and in *China*, *Thea buu*. The other crop is in *April*, and the bloom together with the buds, that grew close together, are gathered; the last are pick'd out, and according to their goodness, are reckon'd equal to those of the first crop: But at last in *May* all is fully gather'd; which crop, indeed, yields the greatest plenty of leaves, and more than both the other crops together; but they are reserv'd for the use of the poor and common people. These three assortments have therefore different names: So, that in *Japan* in particular the first is call'd meal-tea; the second, *Chinese* tea; the third, ordinary tea; and then the worst of all, common tea.

All these sorts are previously prepar'd in the following manner: The new pick'd off leaves are dry'd or roasted, 'till they become crisp, upon an iron plate, under which a fire is made; and by this means the leaves are not only preserv'd from corruption and become more commodious for packing, but they are also freed from their strong and noxious quality; wherefore, to obviate this, they in *China* besides, as was mention'd above, scald the tea with hot water. In each city there are publickly built such drying houses; and in one of these there are oftentimes upwards of 20 furnaces, which are three foot high, and cover'd above with an iron plate, so that no smoke, which would otherwise spoil the tea, can come to it. The fresh leaves thrown thereon run together on the hot plate, and to prevent their burning, they must be continually turn'd with the hand: Afterwards they

How prepar'd.

are thrown upon a long mat, which lies upon a table, and they are roll'd with the palms of both hands, till they are entirely cold; and this operation they repeat several times, and when they would be exact in it, even till five times. In the mean time there sweats out of the leaves a greenish yellow juice, which must be again wash'd out with warm water, if the leaves shall retain an agreeable green colour. The tea thus prepar'd is well kept from the air, and put into tin-canisters; and these are put into a box of firr, especially when they are to be carried to *Europe*.

Tea how us'd in
China and *Japan*.

In *China* tea is us'd most commonly, as with us, in infusion; but the great and rich, especially in *Japan*, take fine ground tea, and throw a small spoonful of it into a cup of hot water, stir it well about, and sip it warm, and this they call thick tea. The common people use to throw early in the morning some handfuls of the worst sort of tea into a large copper full of water, and boil it; and out of this every one, who has a mind to drink, takes some; and when it is too hot, they have cold water at hand to cool it therewith.

Some *European*
herbs preferable
to tea.

We in *Europe* need not much regret our being depriv'd of this tree, as we have many herbs, which are not only more wholesome, and in particular better tasted, or at the least come very near tea; and we may in particular, on account of its agreeable and like taste, recommend lung-wort, mixt with a little *anisum stellatum*, and drank in infusion, which will not be disagreeable to any one to drink, but more pleasant than tea.

To promote health *Gerardus Feltmann*^b has substituted the herb speed-well instead of tea, as it is not brought genuine to us, but oftentimes mix'd with tea, that has been us'd before, or with something else, and speed-well is of service in the gout. *Johannes Francus*, in a treatise, entitl'd *Veronica*, has shewn, that speed-well is far preferable to tea in all diseases; and this curious physician has in particular been more explicite in a supplement, which he afterwards publish'd under the title of *Veronica Theezans*. This matter is learnedly handled in a particular dissertation of Dr. *Frederic Hoffmann*, under the following title *de infusi veronicæ efficacîâ præferenda herbæ theæ*.

He that would farther be inform'd about tea may consult *Jacob Massæus* rer. Indic. Lib. VI. § XII. — *Matth. Ricius* de Christian. expedit. ap. Sinas Lib. I. cap. 7. — *Job. Bontius* dialog. VI. med. Indor. — *Job. Linscotus* cap. 26. — *Alex. de Rhodes* sommaire des divers Voyages & Missions Apostoliques. — *Bernbard. Varenius* in descript. Regn. Japoniæ cap. 23. — *Olearius* in itin. Pers. p. m. 315. — *Job. Jac. Waldschmied.* & *Job. Dolæus* in epist. Amœbæis de rebus med. & philos. In particular *Engelbertus Kämpfer* in amœnitatibus exoticis, who has latest of all travell'd this country; and many more besides.

Of

^b De Deapodagra cap. 37.

Of the Bones of the Animal, which the Russians call Mamont. By
Bafilus Tatischow. From the Acta Literaria Sueciæ. Trimestre
II. An. 1725. p. 36.

Translated from the LATIN.

THESE bones are found in the colder provinces of *Siberia*, in *Jacutsko*, *Beresow*, and in the adjacent parts, as also in *Jeniseisko*, *Tomsko*, *Jututsko*, and in other parts, but not in so great plenty as in the above-mention'd places. There is no searching for these bones; they are only met with by chance by the *Russians* who live there, and by the *Pagan* natives, when they roam about on the account of hunting or fishing: Yet they are met with on the banks of rivers, or in the rivers themselves, or they jut out of the earth, and commonly in those places where the earth has been before wash'd away by floods of water; and sometimes they have lain buried 10 fathoms deep. They are not, however, so scarce, that, in my opinion, if they were collected together from all parts round, they would every year amount to 50, nay 100 *put*, which is equal in weight to 40 *Russian* or 39 *Swedish* marks.

These bones,
where found.

These bones differ in bigness; the larger bones are 10 foot in length, and their thicker extremity is almost nine inches in diameter; the smaller bones do not exceed four foot in length, and two inches and a half in breadth; their figure is almost semicircular, and twisted to one side like ox-horns; at the wider extremity, they have a conical cavity about two foot deep; the anterior point of the bone is always found cut, as it were, and smooth on one side. It has been observ'd, that the larger of these bones weigh 240 pounds, but they are very rarely brought entire to us; for, as they are found in remote, desert, uncultivated, and woody places; and besides, as they cannot be carried far, on account of their weight and irregular figure, they are usually cut into smaller pieces, and sold about the towns.

Description of
these bones.

Their substance and internal consistence is not inferior to ivory; for, it has both its whiteness and solidity, and in working it takes its politure. When they are quite fresh and sound, they have internally a milky colour, but externally they are yellowish: But of such as are spoil'd by rottenness, some are of a palish white; others are observ'd of a yellowish colour, either dilute or obscurer; yet this hinders not their being fram'd (unless they are entirely rotten) into various and elegant pieces of work.

These bones, therefore, differ very much in their constitution: The fresh ones resemble the best ivory; the half rotten ones, whether white or yellow, may be easily cleav'd into plates: The third kind, which is entirely rotten, and which also retains partly a pale and partly a yellow colour,

four, crumbles between the fingers into a dust, resembling either cream of tartar or ground coffee.

The uses of these bones.

I know of no other use to which these bones have been put, than that turners and comb-makers make various wares of them; but for the most part these bones are usually carried into *China*. Whether they may have any use in medicine does not appear.

The tradition of the inhabitants about these bones

The following is the ancient tradition and opinion of the inhabitants of this country as to these bones, namely, that there is a certain huge animal they call *mamont*, which lives under ground, furnish'd with these two bones, which it uses as moveable horns, and makes a passage for himself, when he would proceed any where; and that this animal is of such a nature, as that he cannot live in the open air; and therefore, when it happens, that he gets out of the earth, and is expos'd to the open sky, he dies by a draught of air.

Besides, they tell, that some have observ'd the earth rais'd into mounds, which happen'd while this animal was busy below in digging; and when he proceeded farther on, that the earth subsided again; and that, therefore, he left a tract or certain pit in the surface of the earth, as the trace of his subterraneous passage.

No one has hitherto, however, been found who could aver, that he had seen the animal entire and alive; yet some have related, that they have found and dug up bones, which were not only fresh but bloody.

The different opinions of the learned about them.

I shall now rehearse the opinions of learned men, which however do very widely differ from each other. There are some who fully persuade themselves, that these bones are the genuine teeth of elephants, nor does it appear to them anywise credible, that a huge animal, such as this is, can live and walk under ground: Besides, that these bones are in all respects like ivory, and have not a horny substance; and if in any instance the external figure happen to differ from that of the tooth of an elephant, that might have happen'd from the weight of the incumbent earth; and if they have sometimes put on a certain mineral nature, and lost their bony nature, that that should be ascrib'd to their having lain longer under ground, whereby losing their native heat, they have at last contracted a certain mineral coldness; but the principal difficulty remains still behind, to wit, how elephants could be carried into the outmost parts of *Siberia*. Some are of opinion, that it might have happen'd in the universal deluge, so that the drowned bodies of elephants were by the waves driven thither from the *East-Indies*, and upon the waters afterwards subsiding, or the flood retiring, they stuck in the mud, till they were afterwards buried by the earth being gradually heap'd upon them, in this matter following the opinion of Dr. *Woodward* and others.

But

But such as reject this opinion suppose, that these elephants were carried thither and left there by some army or other. Others, in fine, to explain this, adduce the paradoxical hypothesis of *Cluverius* about the mutation of the axis of the earth; from which it should happen, that places, formerly very hot, should now, upon changing their posture, become cold: And consequently, that at this day *Siberia*, which is situated in the frozen zone, has now no living elephants, as formerly it had; however, that it still shews the remains of those it formerly had. There were also other learned men, who were persuaded that these bones dug out of the earth, were even produced therein; and that they were not the remains of animals, but a certain *lusus* of vegetating nature, as she forms many other things in her bosom analogous to various parts of the animal kingdom, so also these huge subterraneous horns. Others, in fine, tell us from testimonies from *sacred writ*; and especially from a passage in *Job, cap. 40. v. 10.* that no other animal can be more properly meant by the *Bebemoth* of the *Hebrews*, than this our *mamont*. But not to mention any more,

It remains, therefore, that I now adduce what I myself have found: I, The authors own opinion. therefore, chiefly applied myself to procure these bones, or horns entire; and at length, after much labour and expence, I hit on two; one of them weigh'd 183 pound, which is now in the public repository of his Imperial Majesty; the other I made a present of to our university; a third much larger than any of these, but cut into pieces, I myself made into various pieces of work; for, it seem'd very fresh, and nowise spoil'd by age. I, besides, examin'd in the manner of assayers the external crust of these bones, which seem'd to have contracted a kind of mineral nature under ground: Yet I could discover neither sulphur, nitre, or vitriol: Wherefore, I judg'd, that the earth had not imparted to these bones any mineral nature, but rather dissipated what it was before possess'd of, and chang'd it entirely into a *caput mortuum*. At length, after various endeavours, I hit on a part of the scull of this animal, but it was spoil'd by age, and it seem'd to me to be as big as a large head of an elephant. This scull was of a remarkable thickness; its internal capacity, which contain'd the brain, was but small; on the external side, where horns usually grow in brutes, this bone had a kind of protuberance, but very much wore off: So that I dare not aver for certain, that this scull was ever furnish'd with horns, and that this was not rather some other protuberance. I also procur'd another bone entirely spongy, and which from its figure I judged to be inserted in the cavity of the horn, in the manner that in other horned animals we observe, instead of marrow, or rather for support, some other bone included in the exterior horny case. This bone was a foot and a half in length, three inches in breadth, and it also adher'd to a part of the scull. I, moreover, procur'd a grinder, spoil'd by age, yet entire, and 10 inches long and 6 inches broad: Not to mention other bones, as those of the ribs, thighs, and legs.

I after-

I afterwards enquir'd into those pits, which this animal was said to form as it walk'd under ground, and I view'd them in different places; and I think I have discover'd what they are, namely, cavities and passages form'd by subterraneous waters; whence the incumbent earth afterwards unexpectedly fell in; for, in *Permia*, upon examining such a pit, I found a torrent of water gliding under a hill; but it run deeper than I could venture to go down by a rope; yet the noise of the gliding water sufficiently shew'd, that it was no small stream. This pit was upwards of ten fathoms deep. In a farm of *Baron à Stroganows*, call'd *Serga*, there bursts out of the earth a large stream, discharging white and fetid water in such plenty, as continually to turn a water-mill with four pair of stones, and that so equally, that there is no perceivable increase or diminution of these waters; nay, not the least alteration therein even in spring, when all other waters usually swell. I examin'd the contents of this water, but I found nothing besides a *calx*.

As to the above adduced opinions, partly of the Vulgar, and partly of the Learned, I own that I cannot give in to either in all respects; for, that the inhabitants, as being simple and credulous, may in their relations easily exceed the truth, appears even from what we have advanc'd above about the subterraneous passage and moveable horns of this animal. But that the opinions of the Learned about the bones of elephants, brought thither by the deluge, are improbable, is plain even from hence, namely, that it does not easily appear, how they should be carried thro' so many tracts of land, and be collected in this one precise place; and in the same manner it may be a hard matter to prove, that these elephants were by some army or other, or in some warlike expedition, brought to those northern remote countries, where they must have perish'd by cold alone: Besides, the load of earth, however various, could not have caus'd every where the very same difference in these bones, which at this day they have from those of elephants. But it is no reason, why we may not take these bones for horns, tho' they differ from the nature of deers-horns, those of elks and rain-deer; for, these very bones differ among themselves in hardness, and in many respects from those of oxen, goats, and sheep: So that these fossil bones, tho' harder and more solid than the above-mention'd, yet notwithstanding these qualities, they may be real horns; and even the remarkable internal cavity in these bones seems to shew, that they are rather to be reckon'd to the class of horns than of teeth, and that they were parts of an animal different from an elephant.

Besides, that oblong and spongy bone, of which I made mention above, and which I said was in my possession, tho' it cannot be positively affirm'd that it belong'd to these horns; yet at least it clearly evinces, that there now is some animal in nature, or that formerly there was such, furnish'd with huge horns, and larger than we can imagine, or at least than we have hitherto seen.

Such,

Such, as would have this animal to be the same with the *Behemoth*, principally regard the *Chaldaic* version, where the words literally express moveable horns, but yet all difficulties are not thereby remov'd; for tho' no doubt may remain, that these bones are horns, and that is sufficiently prov'd both from the spongy bone above alledged, and the traces of the insertion of the horns in the scull; yet that that bone may be moveable, it can be so in no other respect than as it moves along with the head: I, therefore, conclude, that so long as any one cannot aver, that he has seen this animal, many doubts must still necessarily remain, which must be left to time and farther observations to clear up.

Of the Benjamin and Camphire Trees. By Hermann Nicolaus Grimm. *From the Miscellanea Naturæ Curiosorum* An. I. Dec. II. Obs. CLII, CLIII. p. 370.

Translated from the LATIN.

THE benjamin tree, which yields that excellent gum of the same name, grows in a wood near *Baros*, situated in the western part of *Sumatra*; it is a tree of a beautiful form, of a streight stem and ordinary tallness, and generally of the thickness of a man, tho', doubtless, it might become thicker, were it allow'd to grow, as it is not; for, the inhabitants suffer it not to grow above six years, but fell it, and pull it up as useless: However, they propagate a new nursery from its fruit. What sort of flowers this tree yields I could not learn, but its fruit is of a flat, round form, of the bigness of a small hazel-nut, and included in a husk, which is somewhat hairy; its leaves are tender and soft, below of a pale, but above of a deep green; the kernel of this fruit has a disagreeable and bitter taste, so that it cannot be eat.

Description of
the benjamin tree

The manner in which the inhabitants collect this gum is, as follows: After that the tree is five or six years old, they cut it above at the beginning of the branches lengthwise, but somewhat obliquely, as deep as the wood; whence then this excellent gum runs out, which acquires its maturity and coagulation from the sun and air: When first gather'd it is of a white colour, thin, viscous, glutinous, and pellucid; but in tract of time it acquires a yellow colour. One tree yields not above three pound of gum. There are always two sorts of this gum got from these trees; the first sort is of a beautiful white and yellow colour; the second, thicker, dingy and hard, with a recrementitious admixture, owing to the gum having continu'd longer in the trees, and to the crystalline sand with which the mountains, where the natives inhabit, abound, which with other recrements is by the wind blown into the gum, especially at the time of collecting it.

Benjamin how
collected.

Description of
the camphire-
tree.

In the same place near *Baros* grows the camphire-tree, a large thick tree, but not among the mountains; its wood, on account of its hardness and firmness, is very fit to build with; it has a straight stem, regularly expands its branches, and is of an elegant form; its leaves are large and fleshy, sharp forwards, and when rubb'd, they smell of camphire, which yet wears off, if kept for any time, on account of the volatility of this gum: It yields beautiful fruit, of the bigness of a small hazel-nut, of an oblong round, included in a thin husk, which again like a hazel-nut, is inclos'd in another coat of an elegant form, and of different colours, as red, purple, yellow and green; it covers the whole fruit, and opens above like a tulip.

Manner of col-
lecting camphire.

Camphire is collected in the following manner: After the inhabitants, from external signs, which are well known to them, perceive the tree to be rich in camphire, they strip it of all its leaves, bark, and external wood, as deep as the pith; which last they cleave; in this pith the camphire lodges in an elegant coagulated form, like a fine crystalline foliated salt, which they separate from the pith. From this so large a tree they collect from one to three pounds at most, which is certainly a very small quantity, and which with us in *Europe* they would not think worth trouble, much less sell so beautiful a tree on that account. But I am of opinion, that if these people were acquainted with the art of distilling, and if they sliced the wood into small pieces, they would obtain a far greater quantity of it; for, I observ'd, that the wood, tho' it seems to have no smell of camphire, yet still contains a deal of it; for, if it is saw'd a-cross, it smells of it, and discovers much gum, which the *Japanese* better know how to employ for their own use; for, they abstract by distillation all this camphire from the wood, tho' they are still unacquainted with the manner of refining it. They sell this camphire to *Europeans*, at a cheap rate; and on the contrary, buy at a very high price the thinnest sort of camphire, as also that brought from *Borneo*, because they put a high value on it in medicine. I was of opinion, that that sort of tree in *Japan* was the same with that which grows in *Sumatra*, but by its leaves I found it to be a different species; for, they are thinner, softer, and for a long time yield the smell of camphire, and have as many veins and fibres as those of *Sumatra*. As to the tree in *Borneo* it seems to be the same with that in *Sumatra*, because the camphire, gather'd in the same manner, is of the same nature. The fruit of the camphire tree makes a grateful pickle, and retains the fine flavour of camphire, and it is an excellent antidote and alexipharmic. From the fruit, flowers and leaves may be made distill'd water, distill'd and express'd oil, seeing the wood, when it is opened as deep as the pith, pours out oil in plenty.

Two new Measures subservient to Mechanical Practice. By Christopher Polhem. From the Acta Literaria Sueciæ, Trimestre IV. An. 1725. p. 108.

Translated from the LATIN.

THAT the use of speculative mathematics is twofold, is allow'd by all, who are skill'd in these matters; namely, one, that it is excellently subservient to various arts, which either relieve the necessities of human life, or such as adorn it and promote its conveniencies; the other use, and that not the meanest is, that its study endues the understanding with a certain sense, and, as it were, habit of evidence, whereby it may proceed with greater ease and success in understanding and cultivating the other sciences. As to the first I take it, that both the learned and unlearned are agreed, but not so as to the last; for, there are who imagine that all application to the higher parts of mathematics is useless, on this score, namely as they cannot see, what these barren speculations, as they call them, and only recommendable from their difficulty, can conduce towards the increase of arts: And tho' I am of opinion that these men may be sufficiently convinced of their error by various reasonings and manifold experiments; yet I think there can scarce a stronger argument be made use of to oblige such people to give the mathematical sciences their due value than by showing, that even these more abstracted truths may be several ways made subservient to the purposes of common life; and tho' this has been done very distinctly and learnedly by many, yet I thought it worth the while to adduce some things from the higher parts of the mathematics, whereby mechanical practice may at least be facilitated, if not improv'd. At present it shall suffice to describe two measures or feet, which I have devis'd, together with their use.

A two-fold use of speculative mathematics.

The first of these measures seems from its use, to be adduced below, not to be improperly call'd a *minute-foot*; for, it has that ratio to the length of a simple pendulum, each of whose vibrations is perform'd in a second of time, which 5 has to 18; consequently, since by *Huygens'* experiments, the length of such a pendulum is 3 foot $8\frac{1}{2}$ lines *Paris* measure, the minute foot will be 10 inches $2\frac{1}{2}$ lines, which in respect of our *Swedish* foot, supposing the ratio of 100 to 1099, which is that of the *Swedish* and *Parisian* foot, makes 9 inches, 3 lines, $2\frac{3}{4}$ points; for, this measure, divided in the usual manner into its decimal, centesimal and millesimal parts, is of that nature, that if there be made a pendulum, equal in length to that foot, the number of thirds, wherein that pendulum performs each vibration, will be $=\sqrt{1000}$: Whence it follows, that if the length of any other pendulum be had in the millesimal parts of the minute-foot, and the

The minute-foot

square root be thence extracted, I say, it follows, that that square root expresses the number of thirds, in which that other pendulum vibrates.

Use. The use of this measure is as follows; if the time be required, in which any effect is produced, as for instance, the time in which the wheel of any machine performs one revolution, take a pendulum of any length, which yet let be given in the millesimal parts of the minute-foot, and reckon the vibrations answering to one revolution; and then from the length of the pendulum, thus express'd, extract the square root, this multiplied by the number of vibrations, shows the number of thirds answering to one revolution.

Example. Let it be a great water-wheel, which revolves once, while a pendulum, (whose length let be two minute-foot and two inches, or 4400 points) performs four vibrations, the square root of 4400 is 65 very nearly, which multiplied by 4, the number of vibrations, gives 260 thirds, or 4 minutes, 20 seconds for the time of one revolution.

Other uses. It appears without my hinting it, that the same method may likewise be commodiously applied for discovering the quickness of the pulse in sick people, for finding the velocity of sounds and the like.

The mechanical foot. The other measure, which I have here proposed to describe, I, for distinction sake, usually call the *mechanical foot*; it is equal to the height, which, a body, falling freely from a state of rest, runs over in the fourth part of a second, that is, 1 foot, 3 lines, $7\frac{1}{2}$ points *Swedish* measure.

Use. By help of this measure, the height of the fall, from the time given, as also the time, from the height given, may be easily found; for, if the time spent in falling be t seconds, the space run over will be $= 16tt$ of the mechanical foot; and reciprocally, if the height, which a heavy body in its fall passes over, be put d foot, the time will be $= \frac{1}{4} \sqrt{d}$ seconds. The same method may be applied for computing the times of the ranges of bombs, as also for finding the quantities of water bursting out at flood-gates.

Examples. If the amplitude of the range of a bomb at the elevation of 45 degrees be d feet, the time of the range will be $= \frac{1}{4} \sqrt{d}$ seconds; if the sine of the angle of elevation of the mortar be put $= f$, the radius $= r$ and the amplitude of the range of 40 degrees $= d$ feet, the time will be $= \frac{f \sqrt{d}}{r \sqrt{2}}$.

If the horizontal distance of the mark from the mortar be put $= b$ feet, the height of the mark above the level of the mortar $= \pm b$ feet, and the range of 45 deg. the time will be $= \frac{1}{4} \sqrt{b^2 - b}$, or $= \frac{b}{4 \sqrt{d}}$ seconds, supposing the horizontal amplitude is d feet.

Supposing the same things, if the angle of the elevation be not a half right, but its sine be given $=b$, and the radius $=r$, the time of the range will be $=\frac{f\sqrt{d}}{2r\sqrt{2}} + \frac{\frac{1}{4}\sqrt{2}f^2d}{r^2} + b$.

The quantity of water or any other liquor in one second of time running out at an aperture, whose area is aa feet, is $8aa\sqrt{t}$ cubic feet, supposing the height of the pressure $=t$. If the wheel, whose mean periphery is p , be turn'd by water and the altitude of the pressure of the water be $=t$, and the height of its fall $=f$, each revolution will be perform'd in the space of $\frac{p}{8\sqrt{f+t}}$ seconds.

Some new Anatomical Discoveries, as of the Hymen, the Menstrual Vessels, &c. From the Breslaw Collection, November 1717, Class V. Art. I. p. 341, 481.

Translated from the HIGH-DUTCH.

DR. Heister had this year open'd three bodies in the *Anatomical Theatre* at *Altorff*, and observ'd in them the following peculiarities; in the first, a servant-maid of about 14 years of age, he found the *membrana hymenis* compleat and entire, a thing so uncommon at this day; Of the hymen. the other, a carrier's man, who after eating and drinking plentifully at a country-wake, fell suddenly into a water and was drown'd: In this subject Of the lacteals in a human subject. he found the third day after his death the lacteals in the mesentery so numerous and so full of chyle as cannot readily be observ'd even in dogs, and other animals.

As it is also a dispute among anatomists and physiologists, whether the *menfes* proceed from the *vagina uteri*, or from the *uterus* itself, some maintaining the former, and others the latter opinion, he found in a woman (22 years of age, who had murder'd her child, and who was executed about the time of her *menfes* ceasing) a great many orifices of blood-vessels and marks of blood in the cavity of the *uterus*, but none in the *vagina*; from which he concludes, that the *menfes* come from the *uterus* itself, tho' not in all, yet in most women. From what part the menfes flow.

He also open'd, in the presence of some physicians, several students and surgeons, an eye, in which was a compleat cataract; but he found no film What a cataract properly is, therein, but the crystalline humour as opaque as a pearl and much smaller than usual, as also firmly adhering to the *uvea*; hereby his opinion about the cataract was more and more confirm'd and strengthen'd; and there were communicated to him from other parts the like experiments and observations.

We

Remarks on the
observation about
the *hymen*.

We cannot well in any respect doubt of the historical exactness and truth of these observations, as the accuracy of this author is sufficiently known: However, it is credible, probably also according to the learned professor himself, that from the present instance of a *hymen* cannot be drawn any conclusion for its constant and universal necessity and real existence (as this membrane is nowise universally, regularly, and in all subjects actually to be found) but rather for the more remarkable corrugations of the membranes, which hence according to the diversity of the subjects and the narrowness of these parts in women afford a larger or smaller aperture for the discharge of the *menfes*; sometimes also, rather by an error of nature growing too close, they in process of time exhibit a real membrane. In this manner the *hymen* can in nowise be considered as a constitutive common part of the body, but rather as an excrescence, and even as an error of nature, and which of itself is more apt to be prejudicial rather than anywise serviceable to the body; for, what some advance is not entirely improbable, *viz.* that when this membrane is somewhat too thick, or the closing together of the membranes is but little or not at all pervious, it may give no small occasion to the retention and difficulty of the discharge of the *menfes*, and that to such a degree, that sometimes a manual operation is necessary^a; tho' here also the wounding of the membranes, either of the *vagina*, or neck of the *uterus*, may sometimes have a greater effect in the discharge of the ensuing or apparent *menfes* than any actual opening of a real *hymen*: This however is certain, that it is contrary to the nature of the common parts in the body to pretend, that this membrane once torn can never after be restor'd; as it also commonly has, according to the opinion of most people, fleshy fibres and several vessels: Not to mention other things.

Remarks on the
observation about
the *menfes*.

In the third case the professor has remark'd with good grounds, that in all women the *menfes* do in nowise flow from the *uterus*, and it seems probable to us, that they very rarely, and for the most part rather in a preternatural state, take their course thro' the substance of the *uterus*, as among other things, the *uterus* in a natural state is manifestly wont to discharge nothing but the *fœtus* with the secundines, and at the same time blood also, but blood, by a more violent wound; on which account also a woman in child-bed is to be regarded with respect to her *lockia*, as a person internally wounded: And consequently before consolidation she must be treated with all imaginable care. And tho' indeed we must well distinguish between a violent solution of continuity and between a gentle spontaneous opening of the mouths of the vessels; yet this is not of that weight, that hereby the ordinary discharge of the *menfes* through the very substance of the *uterus* can be sufficiently supported, as the different constitution of the *uterus*, both entirely empty and immediately after the birth can sufficiently decide the matter; as namely after the birth, the blood, upon wound-

^a *Vid.* Diemerbræck Annotat. ad Anatom. p. 64.

wounding the substance of the *uterus*, must not only necessarily flow, at least passively out of the exceedingly dilated veins, but must also especially be actively express'd, that together with the *uterus* the vessels may duely subside, as being out of a state of pregnancy about the thickness of a hair; but on the contrary, in the time of pregnancy as big as a writing pen: Whence it is easy to conclude, that in the latter circumstance the blood must readily flow out and be express'd; but in the former it is certain, it may be retain'd with the like ease, especially as the *uterus* in young women is very firm and exceeding narrow, its substance very thick and close, nay hard; and what is still more, a part, generally so red and full of blood, is in them wont to be more whitish: Whence then it is not easy to conceive, how the blood should flow from so small, thick, and close an *uterus* in young women especially that have their courses; besides, from experience we are to conclude, that women with child often have their *menfes*, and that in great quantity, nay, suffer a perpetual flux of blood; which we must suppose to proceed not from the *uterus*, but from the vessels of the *vagina* and of the neck of the *uterus*; and in reality, that the *menfes* principally and commonly proceed from the blood-vessels of those parts, daily practical observations do also shew; and by means of these one may every day remark a manifest consent between the menstrual vessels and the *viscera*, and parts of the *hypocondria*, as they both have a communication with the above-mention'd vessels of the neck and *vagina* of the *uterus*: But that sometimes, out of a state of pregnancy, blood flows from the *uterus* is not entirely to be denied, yet this rather in a preternatural than natural state: Whence in this case there usually follow more uterine hemorrhages, grumous blood, nay, *mola*'s, with grievous symptoms, and that mostly from mismanagement in the birth, or from an abortion, or a dead child; but these things are not to be applied to the ordinary state of the *menfes*. The marks of the bleeding vessels, observ'd in the above-mention'd case, may, probably, not be referable to the natural state of the *menfes*, as this subject had been a little before in child-bed; and such criminals especially under execution must be consider'd in a quite different state from the ordinary.

As to the last case, observ'd by Dr. *Heister*, viz. the cataract; the ancients suppos'd it proceeded from a film settling in the aqueous humour, which stopp'd up the pupil in such sort, that the rays of light could not pass to the crystalline humour; or, according to the modern opticians, not to the *retina*; whence consequently blindness must have arisen. But M. *Brisseau* in November, 1705, offer'd to the *Royal Academy of Sciences* at Paris, an observation, wherein he rejected this cause assign'd by the ancients, and shew'd that a cataract rather possesses the crystalline humour. But this observation was not thought worth inserting into the *Memoirs of the Academy*, particularly as it run counter to the hitherto openly defended opinion of several of the *Members*, tho' to some others the thing was not dis-

An account of the dispute about the nature of a cataract.

displeasing: So that at length this observation came out at *Tournay* in 1706. And in the mean while the affair drew a greater degree of attention in *France*, and was more favourably receiv'd by a great many, and at last with most people prevail'd, particularly after the experiments made by several physicians and surgeons, as *Dodart*, *Gandolph*, *Leman*, *Raussin*, *Mareschal*, *Petit*, *Aubert*, *De la Hire*, and more especially by *Maitre-Jean*: And tho' among others *Mery* strongly oppos'd it, and in order to maintain the old *thesis*, dissected before the *Academy* a dead man's eye, and endeavour'd to demonstrate the hypothesis of a film in the cataract, with which the dead person had been affected, yet to his surprize he found nothing other than the crystalline humour depress'd and darken'd; so that hence he also went over to *Brisseau*'s opinion. And from this time, to wit, from 1706, what was hitherto taken for a cataract was believ'd to be nothing other than a *glaucoma*; and the ancient notion of a cataract, and of the presence of a film therein, was exploded. After this, at length *Maitre-Jean* in his treatise, *des maladies de l'œil*, publish'd at *Troyes* An. 1707, fully maintain'd this opinion: Upon which it was also publickly defended by *Boerhaave* at *Leyden*, and mostly by the above-mention'd *Brisseau* in a new treatise, entitled *de la cataracte & glaucome*, and publish'd at *Paris* An. 1709. Now this opinion (which, indeed, was not unknown to *Lasnier*, *Gassendi*, and others, but only put in a new light) about the absence of a film, and that the crystalline humour only was affected in a cataract, pleas'd *Heister*, while he was still in *Holland*, so well, that he added this corollary to his *inaugural Disputation*, 'That a cataract is the obscuration of the crystalline, and not a defect in the aqueous humour: Hence in couching for the cataract, not a pellicle, as the common hypothesis bears, but the crystalline humour is depress'd:' And as after this in 1710, he enter'd on the professorship of anatomy and surgery at *Altorff*, he soon publish'd in 1711 his first disputation *de cataracta & lente crystallina*: In 1712 a second: In 1713 a third; as also in the same year a disputation *de amaurosi salivatione curatâ*, all which this year he publish'd together at *Altorff*, much enlarg'd. Now *Wolhouse*, an *English* gentleman and oculist to the late King *William*, strongly oppos'd both this whole opinion chiefly, and particularly at first *M. Brisseau* in two letters to *Le Brun*, which he also farther prosecuted in a letter to *Palfyn*; and further against *Maitre-Jean*: Not to mention other pieces relating to this controversy, wherein he strongly endeavours to maintain the notion of a film. In a letter to *Doppelmayr* at *Nuremberg*, dated June 1715, *Wolhouse* not only particularly answer'd a letter *Heister* writ him the same year upon the merits of this controversy, but he also violently attack'd him in a particular critique, and in other pieces to be found in the *Mercure Gallant*. And with him join'd against *Heister* the *Journal des Sçavans* for the month of May 1716: So that at length *Heister* was oblig'd to publish at *Altorff* in 1717, an apology, and a farther illustration of

of his system about a cataract, *glaucoma*, and *amaurosis* against *Wolhouse* and the *Journal*; in answer to which came out a very short piece, full of nothing else but calumny, as both this and the other pieces on this controversy are publish'd together, and recited in the *dissertations Sçavantes & critiques de M. Wolhouse sur le cataracte, &c.* Besides which we know nothing further about this controversy.

An Essay on the Nature and Remedies of Friction in Machines, arising from the Superincession of Bodies. By G. G. Leibnitz. From the Miscellanea Berolinensia, Tom. I. p. 307.

Translated from the L A T I N.

AMONG the accidental obstacles to machines in producing their effects, friction is none of the least, which you may define *the resistance of the surface, over which the motion is made*; and it takes place, whether a liquid be in contact with a liquid, a solid with a solid, or in fine, a solid with a liquid; or which comes to the same thing, a liquid with a solid. A liquid is in contact with a liquid, and that frequently with a loss of motion, as if a drop of liquor move in another liquor. A solid is impeded by a solid, as when a sledge is drawn along on the ground: And in fine, the mutual contact of a solid and liquid diminishes the motion, as when water moves in a pipe, or on the contrary, when a ship moves in water: And it is well known, that a ship, that has made a long voyage, and beset with moss, makes the less way. Lately a figure of a ship resisting, *cæteris paribus*, the least possible (tho' in that case a regard is had to the directions of the impulse, and not to the asperity in the surface) has been examin'd by very ingenious men from the principles of the higher mathematics, and by the infinitesimal *calculus*, by help of a certain hypothesis, the figure has been discover'd.

Friction what?

But in this place we shall treat of the friction of a solid against a solid, arising from the inequality of surface, which is always something, be the body never so much polish'd, as microscopes shew to the very eye eminencies and cavities appearing every where alternately; whence, as it were, a kind of teeth, and consequently, a saw consisting of teeth, or if you will, a kind of file presents itself; and from the close application of two toothed bodies to each other, there arises, so to speak, a kind of *inserrature*, as the eminencies of the one are inserted into the cavities of the other.

Arising from the inequality of surfaces.

But this asperity resists the superincession, because the progressive motion, whereby one body superincedes upon another, takes not place, unless the eminencies be either broke (and consequently, abraded) or depress'd; or in fine, the teeth of one, as it moves on, be rais'd out of the cavities or

Why this asperity is an obstacle.

intervals of the teeth of the other, which is the case of *revolution*, of which below. The eminencies after depression do either entirely restore themselves or remain somewhat depress'd: so far, therefore, as by a continued friction bodies become more polish'd and have a less degree of friction, in so far are the inequalities levell'd, and they are either abraded, or after depression do not restore themselves: But because at length the matter comes to this, namely, that the friction is very little farther diminish'd, the consequence then is, that the inequalities do by their elasticity almost entirely restore themselves, as when a ball runs over a hairy tapestry, or when a string'd instrument is struck by a bow, and thus the asperity continues almost the same.

The friction
how varied.

And the asperity of the body remaining the same (to which it spontaneously restores itself after the superinceding body has gone off, yet the friction may be varied, and consequently intended and remitted by the increase or diminution of the inferrature, of which above; for the more one body is in superincession appress'd to another, the more is the one wounded by the teeth of the other, and the more deeply do the eminencies of the one sink into the cavities of the other; so far that during the superincession the one renders the cavities or inequalities in the other greater, tho' after its going off, the body by its own elasticity returns to its bare roughness or ordinary inequalities.

The appression
how varied.

The appression varies from different causes, but chiefly two, *viz.* from the weight of the superinceding body, as when sledges and wheel-carriages are very much loaded, and strongly appress'd to the bottom; and from the *nifus* of superincession, which appresses one body to another, while the direction of the superinceding body tends to the very surface of the other; as if the one body would by its motion penetrate into the other, and this may be observ'd in the teeth of wheels mutually acting on each other.

The effect of ap-
pression.

The appression from the weight of the superinceding body causes also in wheel-carriages something that is different from friction, tho, of affinity with it; for, if the bottom were hard, so as to sense not to yield, it would be bare friction, as when sledges move on ice; but generally the bottom yields, and so much the more, indeed, as it is softer or fuller of water; whence depressions ensue, which are not restored by elasticity, but by the softness of the matter flowing together, and then there concur both the difficulty of cutting the earth, as also the adhesion itself arising from its tenacity, as a slimy earth does not so readily let go the wheel. But these things belong not to this place.

Amontons' pro-
blem.
Plate V. Fig. 1.

Amontons' problem is more to the purpose: Suppose a body with a plane surface CD, appress'd by the weight E, to superincede on the plane AB: It was commonly thought, that other things remaining, the friction is diminish'd in the ratio, in which the contact or surface CD is diminish'd: But *Amontons'* has determin'd, that provided the incumbent weight remain the

the same, it matters not how great the surface of contact be; and from this argument I think, that the plane *CD* being increas'd, the contact is, indeed, increas'd, but then again the sustaining parts are increas'd, and thereby the appression in any one part is less, and consequently, the resistance or friction therein is less, and thus an advantage would be compensated by a disadvantage.

Amontons deserves commendation, in that he oppos'd a vulgar error; for, it is very false for the reason mention'd, that, other things remaining, the friction is either increas'd or diminish'd in the ratio of the surface of contact: But yet in this he was out, in that he thought an advantage was compensated by a disadvantage, and consequently, that the matter depended on the pressing weight alone. It would be a demonstrative argument, were the resistance or friction proportional to the depression, and the depression proportional to the incumbent weight; but neither of these can well be allow'd, not the former; for, besides the depression, whereby the eminencies of the one are inserted into the cavities or hollows of the other, the rigidity and figure of the eminencies must be estimated: Suppose a table full of inflated bladders and a ball running on it, it does not follow, that the ball sinking an inch deep into the bladders, is just twice more impeded in its course than sinking half an inch, as the resistance may be varied according to the bigness of the bladders, and smaller bladders do with more difficulty suffer so great a degree of depression, because in their depression there arises a greater compression of the included air; not to mention other hypotheses, from which a similitude may be drawn. But neither does the latter take place; for, the depression will not be double upon doubling the weight; as may be illustrated from the comparison of elastic air: Suppose a piston, by means of a weight laid on it, to be forced a foot deep into a hollow cylinder full of air, it is manifest, that upon doubling the weight it is not forced two foot deep, but that the difficulty increases, as also appears in charging wind-guns. And when the wheel of a loaded carriage sinks six inches into the earth, upon doubling the load it will not, therefore, sink a foot; for, the press'd earth becomes closer and harder to yield: Besides if, as it mostly happens, the weight *E* is not every where equally incumbent on the plane *CD*, the depression every where will not be equal: Whence arise many varieties, which shall hinder the magnitude of the sustaining body from accurately compensating the difficulty arising from appression.

Amontons where-
in to be com-
mended and
wherein out in
this affair.

We have said that the friction is intended also from the *nifus* of superin-
cession; and this happens, when the direction of the superinceding body
is not parallel to the surface of the other, but makes an angle with it,
which the nearer it is to the perpendicular, the more violent is the appres-
sion: Whence arises a kind of *coacture*, or straining; and this especially is
observ'd in the teeth of wheels acting on each other; for, wheels often

Friction farther
increas'd.

exert so great a pressure on each other, that the teeth or cogs are broke, unless their firmness be greater than the resistance of the weight to be overcome by the wheels: In this case, therefore, there is as great a degree of friction, as if one tooth were appressed to another by a huge weight; and sometimes it happens, that the very shafts of the wheels are forced out of their place, if they are not well fix'd.

The remedies of friction what?

I now come to the remedies of friction in machines; where laying aside the physical remedy, such as grease, which renders the surface less rough, we shall treat of the mechanical ones, which are of two kinds; the friction is either diminish'd, or for the greatest part remov'd in *superincession*, or the *superincession* itself is diminish'd or remov'd for the greatest part: The former, namely, the diminution of friction in *superincession* may be obtain'd by a certain manner of *superinceding*, which we call *volution*; but the manner of *superinceding* is either *radens*, *volvens*, or *mixt*: The *superincessus radens* is when of two bodies in contact the same point of the one continually passes thro' different points of the other, or by its motion designs a line on its surface: Thus a sledge moves on the ground, so that any nail fixt into its base may design a line on the earth.

Superincessus radens what?

Superincessus volvens what.

The *superincessus volvens* is when the point of contact is continually shifting; and therefore, there is requir'd a line of the one to design the line of the track in the other; and this is *pure volution*, when the designing line in the one surface is equal to the line design'd in the other surface, such as is the *volution* of a wheel, when it moves on the ground in such sort that you may measure the way by its revolution, and which would happen exactly, if the rope G H L M, whose one extremity G would be fixt to the wheel, the other M to the pavement N P, were wound round the wheel F; for, thus the wheel being impell'd either towards N or P will necessarily proceed by bare *volution*, as the same rope, which was the designing line in the wheel, becomes the designed line in the pavement; for, the rope in rolling is by the wheel laid down in the pavement, namely, if the wheel be impell'd towards N: On the contrary, if the wheel be impell'd towards P, it takes up the rope from the pavement, so that in the former motion there happens a *devolution*, in the latter an *obvolution*.

Pl. V. Fig. 2.

But without this precaution as to the rope or string, it is manifest, that to the *volution* there may be mixt an element of a *motus radens*; so that the wheel may slide: Besides, when it is a proper and bare *volution* the circle proceeding in a right line, does by a certain point of its circumference design in the air a *cycloid*, and moving on another circle, an *epicycloid*: In other respects, whether a circle or any other line rolls along, I by a general name call the line describ'd by a fixt point, a *trochoid*.

Mixt motion what.

A mixt motion consists of a *motus radens* and *volvens*, namely, when the line applied to the base of the *superinceding* body designs a line in the base, but not equal to itself; which happens, while with a *volution* a *motus radens*

radens is mixt, not indeed, assignable by a determinate time, but yet elementary, and repeated by an infinite number of infinitely small elements: Thus indeed, the point of one surface is not applied for an assignable time to the different points of the other surface, but for an elementary time only; yet during even that small time it is not at rest, as in bare *volution*, but it proceeds in the base; and consequently, glances on it, tho' for an elementary space only, as it immediately digresses from the contact, and makes way for another point. This composition of the *volution* with the *motus radens* may be thus commodiously exhibited; suppose the rope GHLM is in the manner above-mention'd wound about the wheel F, and one extremity G fasten'd to the wheel, but the other extremity M loose; so that it may be drawn on the pavement along with the wheel towards P. Thus, therefore, if during this drawing, the wheel F be at the same time impell'd towards N, and exert its *volution*, by that very thing the motion of the wheel upon the pavement will be compounded of the *motus volvens*, on account of the *volution* of the wheel itself upon the rope, and of the *motus radens* on account of dragging the rope on the pavement: And in this case the line, which the wheel designs on the pavement with its lowest point L always varying, will be less than the devoluted rope, or than the arch of the wheel applied to the pavement: But if during the dragging of the rope, the wheel F be impell'd towards P, the rope, indeed, will roll, but so as that it shall roll upon the wheel; but the line, which L, the lowest point of the wheel, designs in the pavement, will be greater than the obvoluted rope, or than the arch applied to the pavement, which takes up the rope: If, therefore, the rope were drawn on the pavement with a wheel without the *volution* of the wheel, it would merely be a *motus radens*, and the same point L of the wheel would always move over the pavement, if the rope were not dragg'd, but fasten'd to the pavement in M, and yet the wheel roll'd, it would merely be a volutory motion, the same point L remaining in the same place of the pavement, but for an unassignable time only, till by a continu'd *volution* it be rais'd from it; but now the motion is mixt, as during the element of *volution* the same point L proceeds at the same time in the pavement, tho' for an unassignable length. Again the mixt motion may also be exhibited thus, not to mention a great many other methods: Suppose the same axis QR, parallel to the horizon, to carry two vertical but unequal wheels S and T, fixt on that axis; and let T one of the wheels, by means of the rope GHLM and of the fixt nails G and M roll on the horizontal plane NP in the manner explain'd; then the motion, which the other wheel S would perform on the subjected horizontal plane UX, touching the wheel, would be mixt.

Let us now apply the *motus radens* and *volvens* to friction: Let the ruler YZ be horizontal, having its teeth perpendicularly erected, on which let the spur-wheel W be incumbent (whose teeth cut into the plane of the wheel,

Pl. V. Fig. 2.

Fig. 3.

The *motus radens* and *volvens* applied to friction.
Pl. V. Fig. 4.

wheel, and continu'd would tend to the centre) and let it move on the ruler by *volution*; so that, during its motion, the teeth of the wheel may answer to the distances between the teeth of the ruler and *vice versa*: In this case it is evident, that the asperity, or the teeth of the ruler and wheel are no obstacle to the motion: But if any one would move the wheel forwards on the ruler without rolling it, the same tooth of the wheel should glance upon several teeth of the ruler, which cannot happen, so long as it is inserted into the teeth of the ruler, and not rais'd, without breaking with great force, or at least bending the teeth, or without itself be broken or bent. The same thing also happens, tho' insensibly in friction, that the superincession is retarded on account of the insertion of inequalities, unless when a body by *volution* incedes on a base, as the wheel on the ruler: Whence it appears, that *volution* is a remedy against friction, and that the nearer mixt motion comes to *volution*, the less friction it has.

This principle
applied in prac-
tice.

Now it is from this principle, that men have set wheels under carriages, nor are sledges of service but upon ice or harden'd snow; and sometimes wheels, or rollers, or even balls are not affixt to the moveable load, but only put under it, which is the better way, when it can be done; for, thus the friction about the axis of the wheel or roller ceases: And besides, when a roller or ball rolls upon the ground (the load in that case may roll on rollers or balls) it happens, that the load moves twice faster on the ground than the ball or roller itself; for, it moves both by the celerity of the roller on which it is incumbent, and with its own celerity upon the roller; but a wheel proceeds with the same celerity with which the carriage itself does: Whence so far a free roller, on which the load is incumbent, is preferable to wheels fasten'd to a carriage; but on the other hand, there is this disadvantage in a free roller, that thus in order to keep on moving there is occasion for new rollers, or balls, because the former are left behind by the load; or it is necessary that there be a person always to carry forwards those left behind, unless the motion of the load be circular, and the load itself also of that form, in which case the same balls or rollers may remain always under the load, and commodiously carry it, since they are never left behind.

PL. V. Fig. 5.

Thus the horizontal circle γ^d revolving about its centre on rollers, in like manner horizontal and pointing towards the same centre, which is vertically under the former centre, tho' you lay a great load on, it may be turn'd round, the rollers themselves being so fitted as always to keep the same distance among themselves.

Volution is not only perform'd, when a firm body is in contact with another, but even with a flexile body, as when ropes or chains run upon pulleys or cylinders, which they move, and it matters not, whether a circle moves under a line, or a line upon a circle; but the *motus radens* would happen, if a rope was to slide upon a cylinder, immoveable about its axis; for,

for, thus we find, that a remarkable friction and resistance arises, which is especially augmented, if a rope be roll'd round an immoveable cylinder : So that this rolling round being repeated for some times, the motion of the rope or string is at length entirely impeded ; and this is the effect of friction : And he who in *Galileo* devis'd that little machine, whereby one might commodiously let himself down from on high by a rope, made use of this consideration.

As rollers bear loads in a twofold manner, either so that like a wheel they have their axis fasten'd to the load, or so as to roll freely : Thus also pulleys are mov'd in a twofold manner by ropes and strings ; for, either they have their middle axis fixt, as is commonly the case, or free, and suspended between ropes, in which case not only the friction about the axis ceases, but also the excavated middle of the pulley gives place to other bodies, as in a certain instrument known to the more ingenious weavers for their tapestry work. Some also suspend the axis of the horizontal wheel from a chain, where the axis itself does the part of a pulley, and thus the friction that was us'd to arise from the incumbent axis ceas'd ; and this may be of service in some cases. From these things is understood, how friction may be remov'd by volution. The ingenious *Perault's* machines without friction, which he exhibits in his notes on *Vitruvius*, are founded on the principle of ropes and cylinders, or pulleys ; and consequently, on the principle of volution.

The illustrious *Dane Olaus Romer*, when at *Paris* in the *Royal Observatory*, formerly consider'd the advantage of volution above the *motus radens* ; for, he observ'd, that the teeth of wheels, as they are commonly made, without choice of any figure, move very awkwardly and incommodiously, as they violently glance upon the teeth of another wheel or ruler : He, therefore, devis'd another figure, by which one tooth should move on the opposite tooth, not by *raſion* but by *volution* ; and this figure, not without the aid of the profounder geometry, he found to be *epicycloidal* ; and it were to be wish'd, that he would publish the whole method of this beautiful invention. We however have what the celebrated *De la Hire* afterwards discover'd about the mechanical use of the *epicycloid*, and such considerations are worthy the putting in practice. But tho' the disadvantage is usually diminish'd by the shortness and number of the teeth acting together (which also is the reason, that the stress being divided among many, they are not so easily broken) yet no small degree of resistance often remains behind, which is chiefly observable in great works, as when by means of the cogs of a wheel the *tongue*, fasten'd to a huge and ponderous stamper, placed vertically, is laid hold on, and the stamper rais'd perpendicularly, and falling down again by the cog letting go the tongue, by the force of its fall it serves for the stamping of bodies, or for the expression of their

The most proper figure of the teeth of wheels.

their juices: And here it is very serviceable, that the cogs and *tongue*, but especially the latter, be of a convenient figure.

The removal of
superincession a
remedy for fric-
tion.

The only remedy, therefore, of friction is volution, in the case of superincession; but the other remedy is the removal of the superincession itself; and this in great measure, at least, is perform'd by a crank, and it is better to employ it both for durableness, and also for the diminution of friction than dented wheels, or *Morland's* oval wheel for raising weights, tho' the effect produc'd by a crank be not equable (as *Morland* objects in his mechanics); yet this is so far from being prejudicial in those cases where it is employ'd, that it rather has remarkable advantages, as when the quantity of water for turning the wheel is small; for, that measure of water is sufficient for beginning the motion, as its operation is also small, namely, when a great portion of a circle makes a small rectilinear propulsion; in the mean time a new quantity of water flowing in, and the ladders being fill'd, an *impetus* is conceiv'd, which at length is then also sufficient, when in the progress of the rotation there is a great difficulty of propelling; but if the resistance was always equal, the wheel at first would not act, till the ladders were fill'd: It would, therefore, rest for intervals, which is often prejudicial. To prevent the inconveniency from the obliquity of the motion of the handles or sweeps of pumps, or the like, may be effected in various manners, and is commonly obtain'd from the length of the rods, which the sweep works, that there be no longer any sensible obliquity, when the motion reaches the piston itself; but if the sweeps are short, they entirely want a remedy.

Many things may still be usefully perform'd about cranks, and one is, that by means of a crank one wheel may turn round another, tho' at a considerable distance, without any cogs, ropes, or the like, as commonly by cranks the rotation only effects a reciprocal rectilinear motion.

A new sort of
pump for mines.

Pl. V. Fig. 6.

J. C. Sturm (in p. 305. of these *Miscellanies*) gives us a scheme of a new sort of pump for mines. I observe, *says he*, that the rods of common pumps are suspended in the manner represented at A and B, where it appears, that upon working the sweep CD, the rods A ascend and the rods B descend; yet so that the point of suspension A describes an arch AE, the point B, the arch BF; and consequently, that the rods are continually work'd backwards and forwards, and can only draw obliquely the piston ascending perpendicularly, and with how much labour it is done appears from the groans and creaks of the machine. I, therefore, began to think so to suspend the rods that they should raise the pistons perpendicularly, as I was persuaded that very great advantage would thence redound to these machines.

Fig. 7.

I would suspend the rods from the oak-plank MN, six inches broad and four inches thick, and moveable upwards and downwards within the grooves of

of the two timbers RS and TV; thro' this plank at both ends I would pass the crank ABX by means of the oblong flits PQ, arm'd in such manner with smooth plates of brass, that the aperture may retain a length twice the radius AB and a depth equal the thickness of the crank; to both axes I would apply the lantern Z to be mov'd by the spur-wheel O; where yet we are to remark, that it will oftner happen, that the radius of the dented wheel is at least half the radius of the lanterns, which is here double: And at length I would place the iron gudgeons D both of the spur wheel and lanterns, each of them on two brass truckles C; and I would make the ratio between the diameters of the gudgeon of the truckle C and of the gudgeon D, and of the truckle itself C, at most subtriple. These things thus done, I should not doubt but the machine might be mov'd without noise, and with much less force than the common sort usually are, and yet a no less effect be expected from it.

A Medical Dissertation on Camphire. By Christianus Henricus Haenel, upon receiving his Degree of Doctor of Physic. At Leyden, Anno 1739.

Translated from the LATIN.

§ I CAMPHIRE is a vegetable body, of a very penetrating odour, Camphire defin'd of a pretty strong taste, not soluble in water, solid, endu'd with some degree of tenacity, melting in the fire, and inflammable: It is, therefore, deservedly to be class'd among rosins, as having their most perfect characters.

§ II. The following things constitute its specific difference, whereby it Its specific difference. is distinguish'd from all other rosins. By a gentler degree of heat than that of boiling hot water, yet by a greater than that of boiling alcohol, provided the camphire be very pure, it becomes entirely volatile, and that indeed in a solid form, such as it formerly was, only that for the most part it leaves behind a dark spot, probably, owing to a heterogeneous admixture: When sublim'd in close vessels by a stronger fire, it also ascends in a solid form, without any *empyreuma*; when brought near the flame, if the camphire be very pure, it flies away without any, or but a very little remainder; but then it smuts the bodies laid over it: It, therefore, distinguishes itself from the other rosins of vegetables, 1. By its peculiar odour, depending on its proper *spiritus rector*, which is not exactly the same in any one vegetable. 2. That all rosins are more fixt than boiling hot water, unless perhaps you except some odoriferous bodies, which, while they are a-boiling with water, let go in a small quantity their essential oil, but they never are entirely resolv'd and sublim'd into vapours (as camphire is) by pouring boiling hot water several times thereon, or

abstracting it therefrom, much less when they are expos'd to such a heat alone. 3. That other rosins, when distill'd by a strong fire in close vessels, do always yield an oil; and therefore, are alter'd from their first consistence; nay contract an *empyreuma*, and most of them also deposit a pretty considerable coal in the distilling vessel. Benjamin alone does in this respect agree with camphire; for, when sublim'd in the same manner, it partly runs into flaky flowers, and partly into a solid, pellucid sublimate, but yet there follows a little oil, and a coal remains behind: And thus benjamin itself suffers a remarkable alteration, otherwise than camphire does. 4. All other rosins, when calcin'd in an open fire, leave coals or ashes behind; but the oil differs from mineral sulphur, chiefly in this, to wit, that the latter is not only more fixt, but that set on fire it yields no black soot, and besides, discharges a very suffocating, acid vapour, under the form of a white fume: Not to mention, that the colour, specific weight, and especially the consistence, differ.

Corollary.

As camphire flies off by a very gentle heat, it easily appears, that when expos'd to the open air, its whole substance at length evaporates; but then after the avolation of some part of it, what remains behind is as odoriferous as before, when it had lost none of its mass: It, therefore, differs in this, from other odorous rosins, as they immediately lose in the open air their subtile essential oil along with their inherent spirit: It is, therefore, proper to keep camphire in close vessels, tho' it does not so soon evaporate, as is commonly thought, nor is it necessary to cover it down with lintseed, which, as is falsely imagin'd, serves by its contiguity to fix camphire.

Scholium.

It is disputed by authors, whether camphire be a rosin, a coagulated oil, or a *sal volatile oleosum*; the last opinion, as being entirely absurd, does not deserve our attention; but the two former are easily distinguishable; for, camphire has, indeed, some characters, whereby it distinguishes itself as well from other rosins as from oils (§ II) but it has also some characters, and those the primary ones, indeed, greatly agreeing with rosins (§ I); however, when it is demanded, whether any body be a rosin, we consider, whether it is solid, or whether upon being brought to the fire it runs and burns, or whether it will not dissolve in water: Now if such a body has its original from the vegetable kingdom, it is call'd a rosin; for, all bodies, denominated rosins, have these characters. Nor do those that differ in determining, whether any body be a rosin, enquire farther into the presence of a coagulating acid, but they rest satisfied with the characters already mention'd. Some people call some mineral bodies, as for instance, mineral sulphur and bitumens, that are of the same nature, as has been mention'd, rosins of the earth.

Several sorts of camphire.

§ III. This species of rosin is brought from the *East-Indies* and collected there in various places. Hence those who have writ the natural history of these

these countries assert, that there is a fourfold camphire, to wit, 1. The native camphire, collected in the island of *Borneo* from camphire-trees in its own natural crystalline glebe, after cutting asunder the fell'd trunks. 2. What is extracted from the root or bark of the root of the *Ceylon* cinnamon-tree by coction and distillation along with water. 3. That, which is in the same manner obtain'd in different parts of *India* from the roots of zedoary. 4. And lastly, the *Chinese*, or rather *Japonesse* camphire, drawn by sublimation from the roots, trunks, branches and leaves of the camphire-tree, thrown together into a copper full of water; this last kind of camphire is chiefly brought to *Europe* in wooden chests in form of greater or smaller masses, and almost of a cineritious colour, generally mixt with several bits of wood, to which the camphire not rais'd by that sublimation still adheres in greater or less quantity. The three former sorts of camphire, and especially that of *Borneo* are collected but in a small quantity, and only procured and kept by the more curious; and that therefore, because they are scarcely brought to *Europe*; and again it is not without reason doubted, whether the second and third species may be call'd true camphire; but we do not dwell upon these.

But, we design at present to examine somewhat more accurately the last sort, to wit, that of *Japan*, as it is the only sort in our shops. The tree, to which we owe the camphire, is like to, or of affinity with the laurel, according to some writers, as *Hermannus*, *Breynius* and *Kämpfer*. *Tournefort* calls it the laurel, as does also *Linnaeus*^a. If any one desires a fuller account of the camphire-tree he may easily have it from the above cited authors. You may also consult *J. F. Gronovius' Dissertat. inaug. de historia camphoræ* at *Leyden* 1715.

§ IV. Hence it appears (§ III) that camphire is a native, vegetable production; for, tho' artists have made various attempts to prepare camphire by art, yet the thing did not altogether succeed, tho' it may be adulterated in various manners; for, there are several sorts of oil consistent in the heat of the atmosphere and in a solid form, from which many attempt to prepare artificial camphire; but it widely differs from the true camphire, as in a dry fire and in close vessels it is never sublim'd without a remainder, an *empyreuma* and the loss of its consistence; nor does such sort of factitious camphire yield the peculiar odour of camphire, which depends on the *spiritus rector*, by which it distinguishes itself from all other vegetables (§ II. n. 1.) as no specific vegetable body, that we know of in nature, can by art be produced genuine from any other vegetable or body; and thus, especially the *spiritus rector*, peculiar to each plant, is entirely inimitable^b.

§ V. The camphire, brought from the *East-Indies* to *Amsterdam*, is infected with bits of wood and other trash that remain after sublimation,

O o 2

(§ III)

^a *Vid.* ejus Gen. plant 338.

^b *Vid.* Boerhaav. chem. P. II. p. m. 18.

Camphire not
producible by art.

Camphire how
refin'd.

(§ III) and for that reason it cannot well be applied to the destin'd uses; it, therefore, wants depuration, whereby the heterogeneous bodies may be separated from it. This depuration, as camphire may without any alteration (§ II) be sublim'd by so gentle a heat, whereby no body contracts an *empyreuma*, is perform'd by the most simple sublimation; nor is there any occasion for additions, which artists would persuade the ignorant to be absolutely necessary. What, doubtless, gave rise to this suspicion was, that some people observ'd depurated camphire sold in solid pellucid pieces; since they themselves have obtain'd camphire, sublim'd in the form of flowers, as they were ignorant of the due degree of fire which must be carefully observ'd here, as also of the just bigness and figure of the vessels: But the whole matter comes to this; if camphire be so sublim'd, that there be applied a gentler fire or a somewhat taller vessel, and hence remaining always colder a-top, all of it ascends in form of very white, shining, flaky flowers; but if it be sublim'd in a low, spheroidical vessel with a narrow neck, not above a few inches high, with so strong a heat that the upper part of the vessel be so hot as may make the camphire just ready to run; but in the mean time care be taken not to stop the orifice nor to apply too strong a fire; and if this last should be the case, the fire to be lessen'd, and the orifice to be open'd by means of an iron-wire, thrust in at times; the sublim'd and half melted camphire concretes into a solid cake of a crystalline transparency; but this you shall not obtain, without chusing such a vessel and observing the above degree of heat. But if it happen, that the camphire is very much infected with any oil, it may be separated by the addition of a little chalk, exactly in the manner as volatile alkaline salts are by chalk depurated from their oil^c.

The process in it.

§ VI. The camphire, thus depurated, is call'd refin'd; the process itself, as it is now manag'd at *Amsterdam*, and as it was formerly done at *Venice*, is nearly in the following manner: They beat the crude camphire (§ III. n. 4.) after throwing away the larger bits of wood, into a gross powder, and passing it thro' a sieve with wider holes, they separate the larger pieces. Of this powder they put about two pounds and a half into a glass-vessel, like a flat spheroidal phial, furnish'd with a narrow neck, some inches high; the furnaces are built in a spacious, high building, like a granary, so as that the sides of the furnaces be join'd to each other; their exterior compass is about two foot, each of them is furnish'd with a *balneum arenæ*; forwards there are apertures made for putting in the fuel and clearing away the ashes; and in these *balnea* they put sand to the height of some inches, into which they immediately put the vessels containing the camphire, for this reason, namely that the alteration happening to the camphire within may be observ'd: Then such a degree of fire is for some hours supplied, that the camphire may run like water, and its humidity;

^c *Vid.* Boerhaav. chem. P. II. p. 366.

humidity exhale, the neck of the vessel being for this purpose open: But lest the humidity should apply itself in dewy drops to the upper and colder part of the vessel, which falling back again would crack the vessel, there are laid on round pieces of cloth, and that threefold, with a round hole in the middle for transmitting the neck of the vessel: These round pieces of cloth are of such a depth as to cover almost half the vessel, by which means its upper part is so strongly heated, that the watery vapours can in nowise be coagulated, but forced out for the same reason; nor can the camphire apply itself there, but being dissolv'd by the stronger heat, it either flows back again or is forced upwards; for, till all the humidity is exhal'd, the camphire never concretes into a pellucid and solid cake: But when a deal of camphire exhales at the same time, they lay on a conical *aludul*, made of filtering paper, to which the flowers of the camphire adhere: The fire thus continued for some hours, is brought lower, and the *aludul*, together with the cloths is removed, and instead thereof a like perforated dish is applied, whereby it happens, that the camphire, which is sublim'd, may accrete to this part of the vessel, as being then somewhat cooler, yet still so hot, that the camphire-particles beginning to melt may run into one solid pellucid mass; the vessel in the mean time is cover'd with an inverted cone of paper to hinder its free exhalation, the fire is again heighten'd, yet moderately, till the whole is sublim'd, leaving the dirt behind at the bottom: But as the orifice of the phial may be quite stopp'd up by the flowers, they keep it always open by thrusting in an iron rod, whereby the flowers are thrown to the bottom; if they do not mind to do this, the vessels burst, and that not without some hazard. The vessels are taken off the furnaces, after cooling of themselves they are broken, and the camphire taken out in form of a cake; and the flowers, which accreted to its internal surface, together with a part of the sublimate, are cut off with a knife and reserv'd for another operation. Thus they have a crystalline cake of camphire, perforated in the middle: And herein consists the whole process recited (§ V) Now let us see what habitude camphire has to some of the principal *menstruum's*.

§ VII. Camphire is dissolv'd by alcohol, and that in a greater quantity the more concentrated the alcohol is; but in a less, the more diluted it is. The greatest quantity of camphire dissolving in alcohol is almost equal the quantity of alcohol; the solution itself is very much promoted by heat; there is again a deal of camphire extracted from the solution when cold, by pouring on water; and in proportion to the quantity thereof, a proportionable quantity of camphire is precipitated: The abstracted spirit, as it is more volatile than camphire, (§ II) carries along with it, it is true, some of the camphire, but it leaves the greatest part of it at the bottom of the vessel, which is sublim'd apart. Such a weakened spirit, therefore, or even if but a little be dissolv'd in alcohol, may easily be mixt with almost

The habitude of
camphire to the
principal *menstruum's*

almost an equal quantity of water, in regard common spirit of wine is nothing other than alcohol mixt with water, only that there is less acid in the alcohol; if also by pouring water to it, the solution should become turbid, this muddiness soon disappears again. There is, therefore, no occasion to distil from a retort, with an addition of salt of tartar, the alcohol saturated with the camphire, if you want a spirit of camphire, diluted with some water.

Scholium.

Alcohol is very easily prepar'd with very dry pot-ash, moderately hot, if one third of these be digested for some hours with spirit of wine, and then decanting the spirit from the subsiding alkaline solution, another and that a less portion of dry, warm salt be added, with which being digested for 24 hours it becomes entirely dephlegmated, all the acid being absorb'd by the fixt alkali: But because some neutral salt, produc'd from the vegetable acid and fixt alkali, is dissolv'd in such alcohol, in some cases it is proper to rectify it. The same alcohol may be produced with common salt in the like manner, but with greater exactness; to wit, if common spirit of wine is by a bath-heat gently brought over thro' a very tall worm, there remains a certain portion of phlegm, which in such an apparatus no longer ascends: The spirit produced is by the like treatment twice digested with an equal portion of common salt, very hot, and abstracted to $\frac{2}{3}$; and thus we have a very pure alcohol, far preferable to that procured with fixt alkali.

§ VIII. Oil of vitriol, if in a certain respect you except mineral sulphur, dissolves all inflammable bodies, and at the same time it puts on a yellow colour; if in a greater quantity, a red; and in fine, a dingy and black colour; for, the purest oil of vitriol, highly concentrated, is by no means of a yellow, dingy or dark colour, but limpid like water, and colourless: There happens the same change of colour, if this acid dissolve camphire, and there strikes out at the same time a quite different odour from what camphire usually gives, to wit, a fetid, bituminous smell, mixt with a sulphureous acid; if the solution is heated, there ascends a penetrating, volatile, sulphureous spirit, not unlike oil of amber in odour. Camphire is precipitated from oil of vitriol by water, and returns to its natural state; the same precipitation happens by the addition of alkali's, as they very strongly absorb the acid of vitriol. At length by sublimation in a strong fire, the camphire itself is in part recover'd, but at the bottom of the vessel there remains a spongy coal, which by too great a degree of heat sometimes froths and sheds over the distilling vessel, and spoils the whole. Spirits of sulphur and alum, as they differ not from oil of vitriol, if equally concentrated, entirely exhibit the same *phenomena*. The quantity of camphire, soluble in oil of vitriol, does in the cold sometimes exceed the quantity of the oil; but by the accession of heat an incredible quan-

quantity of camphire melted along with the oil of vitriol, runs into a thick, dingy *bitumen*.

Oil of vitriol, produced by the most violent distillation, is rectified, if it be again distill'd from a small glass-retort in a sand-heat, in such manner, that in a minute of time about 15 drops may fall, which will be a somewhat acid spirit, and sometimes if the oil be fresh, a sulphureous, volatile, penetrating spirit: It is distinguish'd by the dewy drops appearing on the sides of the vessels, till at length thick veins, counterfeiting oil, come over along with a thick grey vapour; and the drops, which are smaller than the preceeding, as they fall into the recipient to the former spirit, cause a hissing like that of a burning coal thrown into it. After this the receiver is removed, and another hung on, and that very dry and of a moderate size; here there is no occasion for luting too close the junctures of the vessels. Thus a very ponderous, limpid, and colourless oil of vitriol comes over, whose first drops are as generous as the last.

Scholium.

§ IX. A weak, diluted, vegetable acid leaves camphire almost entirely untouch'd; but yet that acid, concentrated by rectification, yet more by cold, and most of all by copper and a fixt alkali, dissolves the more of the camphire, the more concentrated the acid is: But the weight of vinegar does some number of times exceed that of the camphire, dissolv'd in highly concentrated vinegar: The solution at the same time is render'd so light, that tho' in the beginning of the solution the camphire floated, yet when thrown in towards the end it sinks: The solution expos'd to a moderate heat is render'd highly saturated, and then after it is cold, a considerable part of the camphire again separates in a flaky form. It is again precipitated without any alteration, by pouring on water; nay, even by absorbents: By sublimation and distillation it may again in part be separated. When the greatest part of the camphire, after the humidity along with the acid is abstracted, remains behind, it is at last sublim'd apart; but the other part, forced off along with the acid, remains dissolv'd at the bottom of the recipient.

For this experiment the most concentrated vinegar by means of verdigrease should be procur'd: The verdigrease is dissolv'd in distill'd vinegar, filtred, and by repeated evaporations reduced to crystals, call'd crystals of verdigrease: These, well dried with a moderate heat, are first urged by a gentle sand-heat in a glass-retort, and thus the phlegm comes over in dewy drops, without any visible vapour, till upon heightening the fire, the vapour begins to appear dense and white; then the receiver is shifted, and another very dry one is applied; the fire is gradually heightened, till the ponderous, white vapours, and the oily veins, are no longer seen. This will be a very sharp vinegar, which neither the tongue nor nose can bear; but as it partakes of much copper, it must be rectified by repeated distillation; it is call'd *Zwalffer's* vinegar. Vinegar in like manner is saturated

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with

with fixt alcali, and inspissated to dryness, in order thence to procure the solid *tartarus regeneratus*; and afterwards it is again brought over by distillation from a retort, gently pouring on highly concentrated oil of vitriol: And thus there is obtain'd the sharpest vinegar, call'd *acetum radicum*. Observe here the following precautions, that both the recipient and sand-heat be tepid, that the oil of vitriol be put in by drops, and that at first a very gentle degree of fire be applied, afterwards to be gradually heighten'd; for, these highly acid vapours, and of a milky colour, do suddenly burst out with incredible violence; and there is the greatest danger in this operation, lest the retort, on account of the great degree of heat, should burst.

§ X. The more concentrated spirit of nitre is, the more camphire it dissolves into an oily *liquamen*: In this manner, indeed, that the same quantity of acid dissolves a larger quantity of camphire, the less it is diluted with water: While this solution happens, the superfluous water, united with the acid, is forced out of the spirit of nitre, and remains behind at the bottom; but the acid conjoin'd with the camphire floats a-top: Hence the less phlegm there is in the spirit of nitre, the smaller is the mass which is collected at the bottom of the vessel; but the more there is of it, the mass is also the greater. If spirit of nitre be highly concentrated, all of the spirit is receiv'd by the camphire, without the expulsion of the aqueous acidulous particles that lodge below. Hence it appears, that a considerable portion of water, and that in a certain and determinate quantity, enters into the solution of camphire by spirit of nitre, and dilutes it without precipitation; for, highly concentrated spirit of nitre, digested in a close vessel along with camphire, penetrates it, indeed, but does not convert it into so thin an oil; and rather gives it a thick, turpentine consistence. If to this you add some drops of water, the camphire seems, indeed, to separate from the acid in form of flakes; but after that the water is by shaking equally divided, the camphire forc'd out is again very quickly dissolv'd. If you proceed cautiously to drop in the water, the solution is at length diluted like a thin oil: If at length you drop in more water, not only some little part of the camphire is separated (and it is only to be diluted by the addition of more acid, or even by the application of heat) but also by standing a few hours, if there is a sufficient quantity of acid therein, a *molecula* of acidulous water begins to collect at the bottom; and this water is almost equal to weak spirit of nitre. Some small part, therefore, of the acid is so firmly detain'd by the water, that the camphire cannot absorb it. On the contrary, the water of camphire, dissolv'd by an acid, attracts such a portion of the acid, as is requisite for its saturation to a certain degree, and not a greater portion. Hence it happens, that water pour'd on the solution of camphire with the acid of nitre, strikes out the camphire, and as the water absorbs only a certain portion of the acid, we easily gather, one drop of water does not strike out all the camphire, but a certain part

of it only: And this, indeed, is not only to be remark'd about the solution with spirit of nitre, but likewise about other solutions. If any one knows how to temper the spirit of nitre in such manner, as not to be too much concentrated, nor yet too weak, 12 times at least, nay, 16 times the quantity of camphire is dissolv'd, and then little or no liquid is collected at the bottom; nor yet is the solution too thick. If to this solution you add bodies that very strongly absorb the acid of nitre, the camphire is precipitated; and hence also by metals, and their purer solutions: But then it is necessary, that the spirit of nitre, which holds the camphire dissolv'd, be not too much concentrated, and the weaker spirit lodge at the bottom especially; because in a too strong spirit some metals, as for instance, silver, are less readily dissolv'd. Camphire, when precipitated by absorbents, or by water, or rais'd by sublimation, where a coal not unlike that (§ VIII.) remains in the vessel, is found entirely unchanged.

The best spirit of nitre is by solution got from nitre, adding a very little quantity of fixt alcali and quick-lime, depurated by digestion, filtration, evaporation, and a careful crystallization. This depuration is chiefly made for separating the common salt that lies conceal'd in almost all nitre. The crystals of the first evaporation, well dried and comminuted by such a degree of heat, as almost to run, are distill'd from a retort along with $\frac{2}{3}$ of oil of vitriol, and that in the same manner as *acetum radicum* (§ IX. *Schol.*) only that here the recipient be kept as cold as may be. You will obtain a very strong spirit, of a golden colour, and even in the greatest degree of cold bursting out into very dense fumes; it is to be kept in a vessel with a very close glass-stopper; and the vessel is seldom to be open'd; and when open'd to be again very nimbly stopp'd, otherwise the best and most concentrated acid of the nitre soon flies off; and not only the spirit remains weaker, but even at the same time, especially if the air be moist, much phlegm insinuates into it: Whence, at length, it becomes more dilute in its colour, and weaker. The same thing holds of any concentrated acids, and if their best part does not fly off, on account of their fixity, as in oil of vitriol; yet in a short time they contract humidity: And hence the different experiments made with such spirits do not succeed, namely, in such where a highly concentrated acid is requir'd.

§ XI. The strongest spirit of salt, prepar'd in the same manner as spirit of nitre (§ X. *Schol.*) and as *acetum radicum* (§ IX. *Schol.*) does here distinguish itself entirely from all other acids; for, neither concentrated nor diluted, nor by any degree of heat, does it receive camphire into itself, tho' it precipitate it from other acid spirits, as also from spirit of wine itself.

§ XII. The acid spirits of nitre, vitriol and vinegar, dulcified by alcohol, very readily dissolve a great deal of camphire, and that the more, the more acid predominates in them.

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§ XIII. Saline liquors *per deliquium*, or their common solutions, alkaline and neutral, both fixt or semi-fixt, dissolve not camphire, excepting the liquor of *tartarus regeneratus*, and of semi-volatile, neutral salt, prepar'd from vinegar and volatile alcali; for, as being purer they give some ingress to the camphire, a considerable portion of which may, notwithstanding, if requir'd, be mixt by means of the concentrated spirit of vinegar (§ IX. *Schol.*) previously saturated with camphire.

§ XIV. Oils both distill'd and express'd dissolve camphire, but not so readily without a considerable degree of heat, and that not much inferior to that of boiling hot water. Hence such a solution is best perform'd in a bolt-head.

§ XV. We are in the last place to remark, that camphire resists the corruption both of animals and vegetables; so that hence almost all rosins and gum-rosins serve for embalming, as appears from the repositories of natural curiosities.

its medical effects on the human body, and the vanity of explaining the effects of medicines by mechanics.

§ XVI. As the nature and habitude of camphire, with respect to menstruum's, sufficiently appears from what has been said: Let us now consider its medical effects upon applying it to the body. But in regard most physicians do now-a-days almost always undertake to explain the powers of medicines from mechanical and physical laws, and as they look for such demonstrations in medical writings, I ought at the very entrance to hint to the reader, that as I am convinc'd of the vanity of these explanations, and the unseasonable application of mechanical laws to medicines, at least most of them, so I shall not advance one word that may seem to favour of such principles: And I believe any one will easily come into my opinion, if he considers, 1. The incomprehensible smallness of the ultimate parts of any body, which are not discoverable even by the best microscope; I mean those very small parts which the schools call similar, any one of which still constitutes the same body; but which, after a farther division, have no longer the nature of the body of which they are parts, but constitute different heterogeneous principles, from whose mixture the body was before made up. The schools have call'd these the constituent parts. 2. That one and the same effect is often produced by very different causes. 3. That we have no sure principle, from which we may with certainty determine any thing about the figure of mixts. 4. That the mechanical properties of bodies alone, as their figure, hardness, density, and specific gravity, are in no manner sufficient to produce some effects; but that besides, there is requir'd a determinate motion in respect of direction and power, whereby bodies may produce their actions: This moving force immediately manifests itself, as soon as two bodies are mutually applied to each other, and by naturalists call'd the *vis insita*, and relatively consider'd as to the bodies applied, it discovers itself by different effects. Now this force should be distinctly understood by those who attempt mechanically to explain the

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menstrual action of mixts. But pray whence is it known? Let a person take any one of the modern systems, and he will see, provided he is not involv'd in preconceiv'd opinions, that he must either have recourse to hypotheses, or that the *vis insita* of bodies remains always conceal'd from our eyes; nor will it be certain that there is such a *vis* but by experience. Again, if one, moreover, considers that the structure and conditions of the human body differ very much, that its nature or the essence of its ultimate parts, both solid and fluid, are not thoroughly known to us; and hence, that from the various application of the same medicine quite different effects do arise, I am of opinion, he will not doubt, but that the powers of medicines are almost always to be determin'd from experience alone. As we shall, therefore, endeavour to explain the effects of camphire, we shall go merely upon experiments and observations, and the consequences that by just reasoning may be hence deduced. But that the whole may appear the more clearly, we shall premise some general things.

§ XVII. Upon increasing the motion of the humours of our body certain effects immediately arise, to wit, the reciprocal action of the humours and vessels upon one another, as also a stronger attrition of the humours among themselves; and hence a change in all the secretions and excretions, and consequently, in the whole body. That this happens, in proportion to the increase of the motion, appears of itself. Now let there be, 1. A body somewhat stronger and more rigid; let the humours be acrid, and neither so moveable, or let them be affected with any other morbid disposition: In fine, let this quicker and stronger motion of the humours continue a little longer, in a short time every thing will be much chang'd from its natural state; the attrition will perpetually increase, heat arise, the blood, after dissipating the more liquid part, be dried up, an inflammatory sizyness arise, together with the obstruction, destruction and inflammation of the smallest vessels, a beginning corruption, and all those consequences we learn from pathology. But 2. Let the body be of a looser texture, and at the same time let there be a sufficient quantity of mild and pretty moveable humours, tho' the quicker motion may continue for some time, there will scarce be any sensible alterations observ'd; nay, very often health will be thereby very much improv'd; for, as the vessels and humours are more strongly agitated, there is not only a cause producing a stronger fibre, but also upon increasing the secretions and excretions, so far as they depend on an intenser degree of circulation, crudities and obstructions, which are probably present in the body, are concocted and dissolv'd, and they are either excern'd by the proper outlets, or assimilated with the sound mass. Hence it appears, that in different bodies, different effects may be owing to the same cause.

As appears by instances.

§ XVIII. A quicker circulation of the blood is known from the number of pulses; but from a quicker circulation all the sounder physicians agree, that

there is a fever: As, therefore, a fever consists in an increas'd circulation, what holds as to this, will also hold as to a fever; a fever, therefore, will produce the same effects (§ XVII.): Besides, whatever causes a quicker circulation, causes a fever and its effects (*ibid*); but there are medicines, call'd stimulating, which cause a quicker circulation; they will, therefore, also produce a fever and the 'fore said effects.

§ XIX. All vegetable bodies, especially the inflammable, which have a strong odour or taste, and chiefly such as have both at once, being applied to the human body, are found to affect the nerves, rouse the spirits, heighten the oscillatory or contractile force of the fibres, and hence the motion of the humours, both in a part and in the whole body^d. And experience shews, that these things happen in proportion to the quantity applied to the body.

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Tho' here I have said, that all vegetables, that are very odorous and sapid, produce and increase the motion of the humours; and that hence alterations happen, as appears from what was said above: Yet you must not imagine, that, therefore, all insipid and inodorous bodies are excluded, or to be reckon'd inactive; for, the contrary appears from many bodies of the three kingdoms: As to the vegetable kingdom this appears from the root of black hellebore, the *cicuta aquatica* of *Gesner*, the deadly nightshade, &c.^e As to the animal kingdom, some animal poisons affirm the same thing: From the mineral kingdom let us take arsenic and glass of antimony, which are bodies entirely insipid and inodorous in the heat of the atmosphere, and yet when taken into the body, they are highly mortal poisons.

§ XX. As therefore vegetables (§ XIX.) by affecting the nerves and stimulating the fibres, cause a brisker circulation (*ibid*.) excite a fever (§ XVIII.) and its effects (§ XVII.) they are, therefore, referable to the class of stimulating medicines (§ XVIII.).

§ XXI. Camphire is a vegetable body, inflammable, and of a penetrating taste and odour (§ I. & coroll. § II.) applied, therefore, to the human body, it excites the circulatory motion of the humours (§ XIX.) it, therefore, produces a fever and its effects (§ XVII, XVIII.) it is, therefore, to be class'd with stimulants (§ XVIII, XX.)^f.

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Now let the reader consider, that camphire (otherwise than other bodies of the same kind, both natural and factitious) is all of it very odorous and sapid (§ II. corol.) and he will no longer doubt of the truth of this assertion. From many of those bodies, if not from all of them, an active principle may be easily separated (*ibid*.) the remainder being more inactive in respect to the human body: And when these are for a long time expos'd to the open

^d *Vid.* Boerhaav. chem. P. II. p. 16. & Institut. Med. § 1112. n. 2, 3.

^e *Vid.* Boerhaav. chem. P. II. p. 24.

^f Boerhaav. Instit. med. § 1112. n. 2, 3.

open air, that active principle exhales, and the remainder is found more inactive and more fixt (*ibid.*). Camphire in the open air is, indeed, diminish'd as to weight, but what remains of it has the same virtue as what exhal'd (*ibid.*) by distillation that active principle is easily separated under the form of a subtile and very penetrating oil (*ibid.*). And even that essential oil, repeatedly thus treated with spirit of wine or water, lets it go further; and there always remains behind a more inactive and resinous body ^g; but camphire is of a different nature (§ II. *cor.*). Whence also I think it evident, that that principle which constitutes the virtue of any vegetable, and which some call the *spiritus rector*, is in greater quantity and more closely united to camphire, and probably is inherent in a more subtile basis than in other vegetables: And hence also it seems to arise, that being added to some resinous vegetable bodies, as an appropriating medium, it facilitates their ingress into the subtiler *menstruum*'s, an instance of this we have in genuine gum-copal, which is otherwise scarcely soluble in alcohol, yet not all of it; but if the best alcohol be previously almost saturated with camphire, it is at length dissolv'd, tho' in a small quantity, and scarcely $\frac{z}{o}$.

§ XXII. Whenever, therefore, a physician would restore the contractile force of the vessels, either in the whole body or in a part only, and increase the motion of the humours together with the functions depending thereon, that is, excite a fever, and at the same time a pretty large quantity of mild humours and fitted to the transmitting vessels be present, stimulants are indicated (§ XVII, XVIII, XIX, XX.) and therefore, camphire may also in that case be employ'd (§ XXI.)^h.

§ XXIII. But physicians have observ'd, that the effect of camphire, taken into the body (§ XXII.) is principally directed to the skin or habit, that is, produces sweat and a *diaphoresis*; and hence they have class'd it among sudorifics; namely, the more ancient physicians, as they observ'd, that some medicines exerted chiefly their action on this or the other organ of our body, have impos'd various names upon them, for the most part taken from the liquors, excern'd by these organs: Hence they call'd those medicines, which more strongly move the humours thro' the whole body, and at the same time determine them towards the exhaling pores of the skin, diaphoretics or sudorifics. As, therefore, they observ'd the same thing in camphire, they deservedly made it of that class.

§ XXIV. The following circumstances shew that sudorifics are to be given, 1. A beginning or present critical sweat. 2. The tenuity of the morbid matter, dispers'd, or to be dispers'd thro' the whole body. 3. The peculiar temperament of the patient. 4. The known epidemical constitution. 5. The various obstructions every where in the bodyⁱ: But that they

Camphire, in what cases is to be us'd.

Camphire a sudorific.

In what cases sudorifics are to be administer'd.

^g Vid. Boerhaav. chem. P. II. p. 130.

^h Vid. Boerhaav. Instit. Med. § 1112. n. 2. β & § 1114.

ⁱ Vid. Boerhaav. Instit. Med. § 1192.

they may be exhibited with success, it is requisite, that the humours of the body be attenuated and diluted; and that the vessels and their apertures be relax'd^k. It, therefore, appears both from these things and from what was said (§ XVII, XVIII, XX, XXI, XXII.) in what circumstances, and with what precautions camphire should be administer'd.

Coction, resolution and crisis what.

§ XXV. In all internal diseases with matter, when it is to be changed into a sound state, the morbid matter is so to be subdu'd by the vital force, assisted by medicines, and sometimes by the spontaneous change of the matter^l, as to approach more to a sound state and do the less harm: And these things happening, a *coction* is said to be produc'd. If now it be subdu'd so far as to be entirely assimilated to the sound humours; and an equable circulation being restor'd, the whole distemper be laid, physicians say that there is a *resolution* produced: But when still, tho' the crude matter be concocted and render'd moveable, it retains some quality, which resists an equable circulation and stimulates the vessels, and it is at length discharg'd by some sensible evacuation, a *crisis* is said to happen.

Camphire a stimulant.

§ XXVI. And that all these things may proceed well (§ *præced.*) there should be a sufficient and proportionate vital force, namely, that the morbid matter may be mov'd, secreted and excreted. If this force, therefore, be found to be languid, it is to be excited by various remedies, according to the conditions of the disease^m. If, therefore, a physician shall know, that the humours are now less noxious and sufficiently moveable, and that to complete the coction there is only wanting the circulatory motion, on account of the inactivity of the fibres alone, he must administer such medicines, as may excite the moving fibres to a stronger contraction, and move the vessels and humours: In that case, therefore, stimulating medicines are indicated (§ XVIII, XX, XXII.) for, these, upon increasing the motion, produce the effects, mention'd (§ XVII, XVIII, XX.) Again, if the indications (§ XXIV.) allow of it, he will order such medicines, as force the concocted and moved matter (§ XXV.) to the excretory vessels of the skin (§ XXII.) But now camphire (§ XXI, XXII, XXIII.) heightens the strength of the vessels, moves the humours, and determines them to the vessels of the skin: Where, therefore, coction and a crisis are chiefly to be promoted by sweat, you may employ camphire.

Its use in different cases should be determin'd by experience.

§ XXVII. From what has been hitherto said (§ XVII, XXVI.) I think it follows, that the best effects may be expected from the seasonable and cautious use of camphire; but in what diseases chiefly it may exert its salutary virtues, as the powers of medicines should be determin'd by experience (§ XVI.) should be learn'd from the observations of credible medical authors; for, no one can contend, that it is proper in all cases, where the indicants, mention'd (§ XXII, XXIV, XXVI.) are present: But as it would

^k *Vid.* Boerhaav. Instit. Med. § 1191.

^m *Vid.* Boerhaav. Aphor. § 611, 612.

^l *Ibid.* § 926.

would be endless to recite all the cases in which physicians commend camphire, I shall only adduce the more authentic; and therefore, I shall try, whether I can answer the following queries.

1. How may camphire be of service in curing obstructions? I answer, The use of camphire in obstructions. by conciliating a reciprocal motion to the vessels: Hence, where an obstruction is increas'd by a contraction, peculiar to the vessel, it has no placeⁿ.

2. How may it cure inflammations by resolution? I answer, in the same In inflammations manner as (n. 1.) it cures obstructions; for, in both cases, the fibres of the vessels are distended by the stagnating matter: But an excessive tension destroys the elasticity of the fibres. When, therefore, the obstruction and inflammation are recent, and not too large, or by exhibiting proper remedies the stagnating matter is so dispos'd, that the physician discovers from the signs, that only the inactivity of the fibres opposes its plenary discussion, that camphire is highly to be commended in this case both experience testifies, and what was said (§ XVII. n. 2. XXI, XXII.) shews.

3. Whether, therefore, it be of service in all inflammations? I answer, this the generality of authors hold; yet they will give the cautions, mention'd (§ XVII, XXII. and n. 1, 2.)

4. Whether it may be of service in acute fevers? I answer, the quicker In acute fevers. contraction of the heart, together with an increas'd resistance at the capillary vessels, is the compleat idea of an acute fever^o. The *lensor*, therefore, of the humours, blocking up the smallest vessels, together with the *stimulus*, that irritates the heart, should be corrected: We, moreover, know, that in acute fevers the matter is generally so dispos'd in a certain time, that there happens a sudden change of the disease, either to health or to death, which change is call'd critical; and to bring this about, a coction should preceed (§ XXV.); but this requires a sufficient vital force (§ XXVI.): If this force, therefore, be wanting, it is to be excited (*ibid.*) but camphire effects this in a surprising manner (§ XXI, XXII, XXVI.) In acute fevers, therefore, where the motion before coction is too languid, camphire will be of service; and probably also where the nature of the fever and the epidemical constitution are known, while it promotes the cutaneous excretion (§ XXIII, XXIV.) it may be of use.

5. Why physicians commend it so much in the plague and in pestilential fevers? I answer, all physicians as in several diseases, so especially in the plague, revere the *το Θειον*, or the incomprehensible constitution of the air, whose effect we, indeed, see, but its nature we are entirely ignorant of: But whatever that be, which produces the plague in our bodies, is at present matter of indifference: It is enough, that physicians have observ'd, that those affected with the plague feel a very present relief immediately upon the breaking out of a plentiful sweat. Hence they have administer'd

ⁿ Vid. Boerhaav. Aphor. § 109, 126, 127.

^o Ibid. § 581.

minister'd proper sudorifics; among which (§ XXIII, XXIV.) the desir'd effect has taught them that camphire is none of the meanest. Pestilential fevers, as they are not very different from the plague, according to Sydenham, are remov'd by the same remedies.

In petechial fevers.

6. What are its effects in *febrile exanthemata*, especially the *petechiæ*? I answer, as these for the most part have for their matter something which cannot pass the smallest vessels of the habit, but lodges there, but for their cause a preceeding fever; especially as Sydenham teaches, if by a hotter regimen the thin humours are dissipated, and the remaining become more acrid and thick; and hence the whole cure consists in rendering the matter moveable by a large quantity of a mild thin liquid, and in the vital powers persevering in a just temper (§ XXV, XXVI. P). But that these powers are then always languid, the vital actions, greatly impair'd, may shew; it is easily seen what good effect camphire may have; for, it is of service by increasing the vital powers, and discharging by the proper outlets the morbid matter, render'd moveable (§ XXI, XXIV.)

In *flatus*.

7. How it discusses *flatus*' in hysteric and hypocondriac cases? I answer, while a man is in a sound state, and all the *viscera* that elaborate the chyle are pretty strong, he will never feel himself troubled with *flatus*', unless, perhaps, he has taken down a considerable quantity of meat and drink, generating much flatulent matter, or actually fermenting: But as soon as these weaken'd *viscera* are incapable of comminuting the aliments and assimilating them to our nature, all this is natural, and then the person begins to complain of *flatus*'. In hypocondriac and hysteric patients the *viscera* that elaborate the chyle are highly weak; the aliments, therefore, will acquire a disposition suitable to their nature, cherish'd by heat, and they will produce *flatus*': Besides, such persons have their nervous system so moveable, that by the slightest cause they are affected with spasms: *Flatus*', therefore, distending the intestines, their fibres are stimulated to a spasmodic contraction: And hence those excruciating pains and anxieties! Medicines, therefore, are indicated, which, by determining the spirits towards those parts, may increase the strength of the fibres, that they may resist and expel those *flatus*'; but this is what vegetables effect that are of a strong odour and taste (§ XIX.); and of this class is camphire (§ XXI.). It is, therefore, evident, that in such persons camphire discusses *flatus*' by determining the spirits towards the intestines, and corroborating these last.

In suppression of the menses.

8. How in the same women it may promote the suppress'd discharge of the *menfes*? I answer, as by strengthening the fibres of the abdominal system (*n. præc.*) it removes spasms, the blood has again a free circulation thro' these parts, and that circulation promoted: Hence all the secretions and excretions are assisted (§ XVII, n. 2.).

P Boerhaav. Aphor. § 725.

9. What

9. What, therefore, is the discussing and anodyne force of camphire, so much cried up by some? I answer, it consists in this, that it restores the tone of the fibres, and thus sets a going stagnating humours, and which by distension cause pain, and discharges them out of the body.

Its discussing and anodyne force what.

10. What is its refrigerating virtue? I answer, in all diseases with matter, after resolution or a crisis (§ XXV, XXVI.) the symptoms cease, and all the functions are restor'd. As, therefore, these things happen in inflammations (n. 2.) and acute fevers (n. 4.); together with the other symptoms, the heat also ceases; and that in this sense a refrigerating virtue may be ascrib'd to camphire any one will allow.

Its refrigerating virtue.

11. Does, in fine, its discussing and refrigerating virtue depend on its great volatility? I answer, it seems not; for, from its volatility alone these virtues cannot be conceiv'd, as alcohol, much more volatile than camphire (§ II, VII.) does testify: But yet when it is taken into the body, it both coagulates the humours and produces heat.

On what the two preceding qualities depend.

§ XXVIII. Every one, even without my hinting it, may see, that camphire alone is rarely to be us'd in diseases; but that at the same time other medicines, answering to the other indications, are requisite; as these, therefore, shall vary, the medicines also will be various: Yet generally there is internally occasion for inciding, attenuating, paragoric, and antiphlogistic medicines, accompanied with much of a diluting liquid (§ XVII, XXII, XXIV.). Above all others, neutral salts deserve the commendation confirm'd to them by experience, and among these, nitre, *tartarus tartarizatus*, *tartarus regeneratus*, and chiefly *sal salsum semivolatile*, in regard it is a salt almost of the same nature with our humours; hence it is very kindly to the human body, and at the same time high'y penetrating. We may easily see, that camphire, united with spirituous substances, is with great caution to be administer'd internally; as besides, daily experience shews, that these spirituous substances are of greater service than the external use of camphire.

Cautions in using camphire.

§ XXIX. And in fine, the form, in which camphire is to be exhibited, may be easily determin'd, if either its external or internal use, and at the same time the medicines to be taken, are determin'd. Most people prescribe a strong dose, and that from half a scruple to a whole drachm; it will, therefore, vary, according to the circumstance of the patient and the intention of the physician. Internally it is best given with salts (§ XXVIII.) and other proper bodies in the form of powder along with a sufficient vehicle; under this form it may enter into almost all the pharmaceutical preparations, which admit of powders: But if you would mix it with liquid medicines, you must observe, 1. That there should be no intense heat for preparing the camphorated medicine, or that the camphire be then at last added, when the heat is over (§ II.). 2. That liquids do not oppose the mixture of camphire; but that there should be a liquid, approaching to

The form in which to be exhibited.

the nature of some *menstruum* (§ VII, XIV.); for, by this means it may be afterwards mixt with liquids, otherwise not miscible, without any apprehension of all the camphire being precipitated. Externally it is best applied, when resolv'd in spirit of wine, or in oils (§ XIV.) in the form of unguents, or other the like thing; but it is best to employ spirit of wine not too strong, because pure alcohol, or spirit of wine, highly rectified, dries up the fibres too much, and coagulates the liquids^q. The use of camphorated spirit of wine is sufficiently known to surgeons, on account of its excellent uses^r; but it acts partly as alcohol, and partly as camphire, and that in the same manner as mention'd (§ XXVII. *n.* 1, 2, 3.).

Scholium.

Camphire alone, on account of its tenacity, cannot be commodiously powder'd; for, in grinding it, it always coalesces again; it is, therefore, proper to interpose such bodies, as prevent its immediate contact and this its coalition; and for this end a drop or two of water are sufficient, being sprinkl'd either on the camphire or mortar: But if you have at hand somewhat humid salts or other bodies, there is no occasion for water.

§ XXX. As the officinal preparations, in which camphire is an ingredient, are few, and as it may be judged what their effects are, and in what cases they are proper, from knowing the other ingredients, and from what has been hitherto said, these I readily wave.

^q Vid. Boerhaav. Chem. P. II. p. 224.

^r Ibid.

Of the Origin of the Esthonians, Finns, and Laplanders. By Olaus Rudbeck, the Younger. From the Acta Literaria Sueciæ. Trimestre III. An. 1727. p. 300.

Translated from the LATIN.

The origin of the
Esthonians, &c.

AS to the origin of the *Esthonians, Finns, and Laplanders*, I am of opinion, that these nations are referable to the remains of the ten tribes of *Israel*, which *Salmanasser*, King of *Affyria*, carried captive out of *Canaan*, and caus'd convey into desert and uncultivated places of *Persia* and *Media*, such as *Chalach*, *Chabor*, *Gosan*, &c. whose names are recited in *Scripture*: But it is surprising that, from the time the *Israelites* were carried into captivity, no historian made mention of them; whether they remov'd to any other part, or whether they were lost in those places wherein *Salmanasser* order'd them to settle: However, the words of the author of the IV. Book and 13th Chapter of *Esdras* deserve to be taken notice of; 'These are, *says he*, the ten tribes, which were carried captive from their own land in the days of King *Hosea*, whom *Salmanasser*, King of *Affyria*, carried into captivity; and he carried them beyond the river; and they were brought into another country: But they resolv'd with them-

‘ themselves to leave the multitude of the nations and go into a farther
‘ country, where mankind never inhabited, and there observe their own
‘ laws, &c. For, thro’ that country there was a great way, a journey of
‘ a year and a half; for, that country is call’d *Arfareth*: Then they inha-
‘ bited there even till latter days.’

I labour not to establish the credit of this writer: However, if he speaks
the truth in this matter, I know not whither the *Israelites* betook themselves, Whither the ten
tribes remov’d
after their capti-
vity. unless to that part of the north, where mankind never inhabited; and that
journey from the *Euxine* sea to *Lapland* requir’d, on account of their chil-
dren, flocks, effects, &c. the time, he mentions, of one year and a half to
accomplish it. What stress is to be laid on *Asareth*, which answers to the
name of the town *Arfaratha* among the *Scythians*, according to *Berosus*,
the reader may judge. The *Oserietha* of *Pliny*, indeed, as it differs not
much in its letters from *Arfaratha*, so is it an island on the coast of *Ger-
many*, abounding in trees of the cedar-kind, from which amber trickles
down upon the rocks. It is not without reason, that I take this island to
be *Scandia* or *Scandinavia*; here is the juniper, in *Swedish*, *enbær*, a species
of cedar; there also is the fir or pine, which many of the Learned take
for cedar, at least they think it a species of it: And in *Scandia* there are
whole woods of this sort of trees. As to the etymon of the word *arfareth*,
it is made up of the two *Hebrew* words *Arez*, that is, *land, country*, and
ares, *cedar, pine*, which the *Chaldeans* and *Arabians* call *arza*: Whence
Arzareth is the same, as the *country of cedar or pine*.

From this signification we seem to discover either *Oserichtha* or *Scandina- To Scandinavia.*
via, which alone supplies all the world besides with the greatest quantity
of amber. *Schindlerus*, in his *Lexicon Polyglotton*, has the following things
of cedar, ‘ it is the tallest of trees, a kind of fir, not unlike the juniper.’

But there is no occasion for other testimonies and arguments for claim- Prov’d from the
language of the
present inhabi-
tants.
ing *Asaratha* or *Oserietha* to *Scandia*, if there are nations therein whose lan-
guage plainly shews, that they are the offspring of the *Hebrews*. These
nations are the *Laplanders*, *Finns*, and *Esthonians*, which for a great part
speak *Hebrew*.

There is not, in my opinion, when history and the monuments and
traditions of past ages are silent, a surer way for discovering the originals
of people, than that which the greater similitude of their language shews.

We must however own, that there are remains among all nations of the
primogeneal language; but excepting the *Syriac*, *Chaldaic*, and *Arabic*, you
will scarcely find so great an affinity with the *Hebrew*, as in the language
of the *Finns*, *Laplanders*, and *Esthonians*; for, here we may see the
very roots and significations of *Hebrew* words, their method of declining
by tenses and cases both their verbs and nouns, many of which, in imita-
tion of the *Hebrew*, answer to the four conjugations of the grammarians:
To which I may add, that the *Laplanders* and *Finns* do still to this day

use, besides the *affixa*, as they are call'd, also the *suffixa*, things I know not, whether observ'd by others. *Cajanus*, in his *Academical* dissertation *de convenientia linguæ Hebraicæ & Fennicæ*, rightly hints that their separable and inseparable pronouns are similar to those of the *Hebrew*, tho' he adduces but a few instances; that from feminines of the plural number substantives are form'd, as in the *Hebrew*, is plain. *Naar*, for instance, in *Hebrew* denotes an *infant*, *boy*, *youth*; *Nuor* to the *Laplanders*, *Nuori* to the *Fins*, denotes the same thing: Whence *Neuroth* in *Hebrew* signifies *childhood*, *youth*; *Nuorawoth* to the *Laplanders*, and *Nuorus* to the *Fins*, denotes the same thing.

But in this dissimilitude of the words you must not attend to the change of the vowels, but to the roots themselves, which are constituted by the consonants; and how inconstant the vowels are, the *Swedish* word *kung* shews: The *Danes* pronounce it *Kong*; the *English*, *King*; the *Germans*, *Konig*, &c. the consonants are the same, the vowels different. *Naar* in *Hebrew* signifies he *agitated* or *shook*, &c. *Narthi* or *Nardi* denotes the same thing among the *Laplanders*. We have many other instances which I omit. No one of the Learned will be surpriz'd at those lesser variations of letters of the same organ, and of words in cases and terminations; because after letters and the art of writing, receiv'd from our ancestors (which alone can put a stop to the destruction of languages) are lost, it is no wonder that languages suffer.

I conjecture, that *Odin I.* as history informs, did not only exercise his power over the nation, but likewise on the language; and that he alter'd it.

From the names
of towns in the
north.

The opinion I above advanced, namely, that the *Israelites* came from *Persia* and the *East* to the north, gains strength, if we at the same time shew, that many names of towns and villages in these northern parts differ not from those in *Asia*: They have likewise the same sound and signification; and among many others I shall adduce the few following: *Hallola*, the name of a town or village in *Persia*, in 34° of latitude, is also the name of a village in *Tavastia*, in 62° of latitude, and also of a lake in the same country: *Jumalech* and *Jumalen*, a village in 38° : *Jumalai* in *Finland* of 61° : *Chaja*, a village in 40° : *Caja*, hence *Cajansalmi*, that is, *the Streights of Caja* in *Cajania* 66° : *Ollau*, the name of a town near the river *Kurr* in 43° : *Oulou*, a town and river in *Ostrobothnia* 66° : *Cbecmechu*, a village in *Persia* near the mountains 34° : *Kekimechi*, a village of *Finland* 62° , as also *Seckmechi*, and according to others, *Sexmechi* in *Tavastia*, 62° : *Rasalain*, a lake in 36° : *Rozelain*, a lake of *Carelia* in 63° : *Vassa*, a town on the other side the *Euphrates* in 33° : *Vassa*, a town and river of *Finland* in 60° : Besides a thousand other names in the north answering to and like those in *Asia*.

From traces left
by them between
Persia and *Finland*

Besides, what rout these exil'd ten tribes took to the north, the traces left by them between *Persia* and *Finland* do testify, as the appellations of lakes,

lakes, rivers, villages, &c. to be seen in maps or in travels: And I should say, that these particulars were of the greatest weight for discovering the origin of the *Finns* and *Laplanders*, nay, even of the *Esthonians*, were not the following particulars of equal weight with the preceeding.

From their long commerce with the *Persians*, there still remain among these nations a great many *Persian* words, which in numbering are us'd by the *Laplanders* alone, and their neighbours in *Europe*.

A *Laplander* is very brawny, strong, and nimble: And as from the habit From their bulk. and bulk of their body you may distinguish an *Israelite* among the *Riphaean* mountains, he will own, when he comes down to *Helsingen* and the parts nearer to the *Goths*, what his ancestors own'd, when they came to spy the land of *Canaan*, namely, in respect of the tallness of the inhabitants, that they were but *grasshoppers* to them, as some translate it, or rather *partridges*, as I think^a.

Besides, the customs of the ancient *Hebrews* in entering upon an inheritance, in saluting, in embracing, in crossing their legs in sitting, and in other respects, swell the number of my arguments. They still retain the *Hebrew* appellations for their cloaths, shoes, household furniture, and animals; and, also in the manner of their ancestors, the *Laplanders* worship the deity by sacrifices, falling down on their faces, by anointing, by building temples, and by calling their Gods *Jumala*, *Thor*, &c. in all which, they imitated the *Hebrews*, and in those early days they follow'd the *Hebrew* computation, beginning the year from *March*, and not from *January*, as with us, nor from *September*, which was the first month among the *Russians*, and *Saturday* was their sabbath. From the Hebrew customs, &c. among them.

I propose to prosecute these things in my *Thesaurus* of the *Asiatic* and *European* languages, and in a peculiar work on the origin of the *Finns*, *Laplanders*, and *Esthonians*.

* Numbers c. 13. v. 34.

The Anatomy of two Beavers; together with Observations on them.

By Joh. Jacob. Wepferus. *From the Miscellanea Naturæ Curiosorum.* An. II. Obs. CCLI. p. 349.

Translated from the LATIN.

IN this beaver (which was of a large size, weighing upwards of 30 lb.) The dissection of the first beaver. the shape, colour, hair, head, teeth, both the incisors and grinders, the fore and hinder feet, and, as it were, its scaly tail, were in all respects, as we find them describ'd by *Gesner*, *Aldrovandus*, and *Johnston*, only that the tail at its extremity was furnish'd with very short and roughish hair. This subject at first seem'd to be a female; for, in the *inguen* appear'd an oblong and rugous *rima*, at whose sides internally on each hand a *sinus* enter'd.

enter'd into a remarkable body, a palm broad, a palm and a half long, two inches thick, and upwards in some places. After stripping off the skin, which for the most part, as in a man and swine, adher'd closely to the subjacent muscles and fat; and upon pressing the parts in the *inguen*, there popp'd out of the upper part of the *rima* a bony *penis*, cover'd with a *præputium*; but there no where appear'd any thing like testicles. Afterwards came to view those large bodies, or protuberances, in which on each side the *sinus* from the *rima* terminated: They were not an uniform body; for, the upper part of the protuberance appear'd both firmer and harder, and, as it were, a body conglomerated and compos'd of several hard glands, some of which were as big as a walnut: The lower part was an oval vesicle, of the length of a goose-egg, but flatter rather than exactly round. Upon pressing the glandulous body there came out a waxy substance, as it were, smelling strong of castor, and friable; but upon squeezing the vesicle, a whitish liquor run out, oily, viscid and clammy, very fetid, and smelling like rotten cheese: Each follicle held about three ounces of this liquor; but both the conglomerate bodies scarce supplied an ounce of the waxy substance. Upon cutting lengthwise the vesicles, they were internally smooth, but seem'd furnish'd with little eminencies and several minute holes, from which, upon compressing the vesicle externally, there ouzed out a liquor, in colour, odour and consistence entirely like the contain'd liquor.

Upon opening the *abdomen*, the testicles came to view, observ'd in no manner fixt to the spine, but anteriorly incumbent on the internal region of the *os pubis*, where was a superficial *sinus*, about the place of the *processus peritonæi*; to wit, on each side half the testicle with the *epididymis* lodg'd in the said *sinus*, and hence were easily taken out, as the testicles were thought not to pass the *peritonæum*, nor grow to the shallow *sinus*. The testicles, in proportion to the bulk of the animal, were small, scarce as big as pigeon-eggs; were white, smooth, and of an oval figure, but compress'd where they regarded the intestines, envelop'd in one thick, nervous coat; internally white as snow, and furnish'd with a substance, as it were, of fibres, closely compacted, and impregnated with neither waxy nor oily substance, and without the sharp smell of castor, nor form'd, as to admit of any cheat, or be adulterated by any art. The *vasa præparantia*, encompass'd with a copious fat, descended to the testicles in the common way; but from them and the *epididymides* the *vasa ejaculatoria*, at first for some way winding, did afterwards proceed in a straighter course towards the back part of the neck of the vesicle, and to the *prostatæ*. Upon compressing the bladder the urine squirted out thro' the *urethra*, join'd to the *penis*. There did not appear the least trace of an *uterus*, so that we could no longer have the least doubt about the sex of this beaver. The whole *abdomen*, which was greatly distended, was for the most part fill'd

fill'd up with the stomach and intestines. The thin guts were upwards of nine *German* ells in length: The *colon* with the *rectum* made two ells: The *cæcum* came out from the left side, which I remember not to have observ'd in any other animal; where nearest the *colon*, it was above an ell in length, and very large, and counterfeited the stomach full of meat; it was stuff'd with excrements and wind, but its extremity was slender, of the length and figure of a small finger, in which was lodg'd a gross, dry, and blackish excrement. The *colon* and *rectum* contain'd hard and dry *faeces*. The *pancreas* two spans long, thin and reddish, was fasten'd to the *duodenum* and *jejunum*, but what lay under the splenic vessels seem'd more whitish and thick. The spleen was very slender, scarce a finger broad, a span long, of the thickness of a goose-quill, pale and tender. Both the kidneys were flat, round about like a sharp knife, and where thickest scarce a finger thick. The *carunculae papillares*, in which long and streight furrows were very conspicuous, were large and long. The liver was divided into six lobes, from each of which the biliary ducts coming out were inserted into a larger *ductus choledochus*. The gall-bladder was full of a liquid gall. The diaphragm appear'd strong and very nervous. The lungs seem'd very light, whitish, with some red intermixt. The heart was nearly as big as that of a larger dog; its right ventricle was distended with a fluid and watry blood. The *cartilago ensiformis* was very broad, concave, like a child's spoon; round about, it was cartilaginous, in the middle, bony. The structure of the stomach, which I very carefully examin'd, was quite surprising, it was very large, much like that of a sow or dog, only that a somewhat deep furrow divided, as it were, its middle, as if it had had two stomachs: Again in the left lateral part near the stomach, or its left orifice, I observ'd a ruddy portion, fleshy, upwards of a palm in length, a palm broad, and oval. I at first imagin'd, it was some disease or inflammation, because this ruddy part was higher than the other coats; I cut at the top lengthwise from the *pylorus* to the stomach, and it was all of it full of pieces of barks and roots of trees, with which was mixt some pieces of the rinds of apples and pears, but there was not the least appearance of fish or crabs, nor did the contents smell any thing fishy, as I have more than once found in dissecting an otter: Upon removing the greatest part of those pieces, there was water found at the bottom of the stomach: Upon wiping the stomach, the internal *parietes* remain'd, notwithstanding, besmear'd with a certain *mucus*; where the furrow appear'd externally, there, internally was observ'd a certain nervous prominence, which, notwithstanding, was not so high, nor did it divide the stomach in such manner, that it must be reckon'd two: In that place, where the fleshy, ruddy portion was seen externally, internally a great many holes or mouths came to view, mostly round, and admitting a lentil; some of them like a half moon, especially the upper holes and those nearer the stomach: The internal coat

of

of the stomach being gently remov'd about these holes or mouths, or upon making an incision into one or two of the mouths, under each of them appear'd several smaller mouths opening into the outmost mouth that was cut. Upon pressing externally the ruddy portion, a white, manifest, tough *mucus*, smelling of castor, ouz'd out of the mouths, and when pour'd to warm milk it curdl'd it a little. Upon blowing into one or two of the mouths, a small portion of the ruddy substance swell'd externally; but upon thrusting in a probe, which was easily done after taking off the internal coat, its knob was touch'd by the external, and directly opposite part of the ruddy substance to the mouth. Upon removing the membrane, it soon appear'd, that this ruddy covering part was a muscle, furnish'd with streight fibres, parallel to the external fibres of the gullet. Upon cutting lengthwise this membranous muscle, as it were, small convex bodies, or little glands appear'd; and after carefully removing the whole muscle, we observ'd with surprize convex, oblong, reddish bodies, adorn'd with very minute blood-vessels, and both broader and longer than a corn of wheat, and as arranged in order: These we observ'd like the seeds of a peel'd pomgranate, or the seed of maiz or *Turkish* corn, fasten'd to its stalk, but arranged in a quite more beautiful order; for, no one stood higher than another, or swerv'd from a right line, or exceeded another in bulk, but they were placed, according to the streightness of the fibres. Upon expressing the *mucus*, some of them subsided in the manner as ripe pox are depress'd and become rugous; but upon thrusting in a probe, or inflating them, they again became convex: So that thence we might easily gather, that these convex corpuscles were nothing other than the extremities of canals, ducts, or channels, terminating from the internal mouths into this muscular external portion; which afterwards appear'd more manifestly upon separating these small convex bodies; for, we saw they were small, short, membranous canals, join'd by means of fibrils, and in which the *mucus* was laid up in the manner as bees lay up their honey in combs; namely, as the food of the beaver is dry and very hard of digestion, the wise author of nature has supplied him with this beautiful and curious structure, that the animal might never want a ferment proper to dissolve it.

And of the second.

In another beaver, which was thought to be scarce a year old, and not above 15 *lb.* in weight, two foot long and one broad, the head was flat, the eyes small and blackish, the ears small and round, the nose flat, the incisors broad and prominent, the two superior, yellow, the inferior, more red, the neck short and thick, the fore feet furnish'd with five toes, and arm'd with round but obtuse claws; the toes of the hinder feet join'd by a thick black membrane, with blackish broad claws, like those of monkeys; all the hair soft, but firmer, thicker, and dingy on the back, softer, shorter, and whitish on the breast and belly; the tail was upwards of two palms in length, three inches broad, of the thickness of a little finger, black and scaly,

scaly, as it were, but really not so; for, the black skin was indented, latticed, and as of a cartilaginous consistence: With this tail in swimming they are said to strike the water strongly in a very agreeable manner; it was thinner at the extremity, and not shaggy as in the former subject. Under the skin, especially on the buttocks, loins, and *abdomen* lay the fat; whence it was taken off with difficulty; it came away more readily on the back, breast, and limbs; which, however, was oppos'd by portions of the *panniculus carnosus*, fasten'd to it. Upon opening the breast, the heart was as big as that of an ordinary dog, the right ventricle quite rugous, as if it were sew'd up, and blackish; the left ventricle fleshy, thick, and smooth; both the auricles rugous; the *foramen ovale* was clos'd up; the diaphragm in the middle every where nervous and strong; the *cartilago ensiformis* upwards of an inch broad, concave and cartilaginous round about; the stomach much smaller than in the former beaver, and also furnish'd with a furrow in the middle, and, as it were, divided into two stomachs; the red eminence near the stomach was three inches and a half in length, two and a half broad, and one high: Upon removing its very thin covering, a muscle or muscular membrane appear'd, of the thickness of the back of an ordinary knife, furnish'd with streight fibres, which tended downwards from the end of the gullet; for, there it began; it encompass'd the superior part of the stomach in such manner as indeed to be extended towards its anterior part, yet declining more to the left, without encompassing the whole stomach; and tho' it appear'd continu'd with, or at least contiguous to the gullet, yet upon gently separating its extremity, both it and the subjacent parts were found to be a whole inch asunder from the gullet, but continu'd with the middle coat of the stomach: Upon removing the muscular membrane there soon appear'd the *apices*, or blind extremities of little canals like the seeds of maiz or pomgranates, and dispos'd in a very beautiful order, whitish and soft. I gently separated these extremities, and the small canals themselves, from each other; at their top and in their progress they were join'd by very tender and easily separable fibrils. The small canals were in length about half an inch; on the sides, and at the bottom near their insertion into the stomach, stain'd, as it were, and cover'd with minute blood-vessels; some of the canals proceeded in a streight line towards the coat of the stomach, and were obliquely inserted into other intermediate small canals, or near the bottom; whence some of them became there wider and larger, before they reach'd the coat of the stomach. Upon cutting the stomach from its top to the *pylorus*, I found it stuff'd with mere pieces of barks and wood, nor could we observe any trace or smell of fish or crabs; and a beaver-hunter inform'd me, that in the many beavers he had taken, he had never found any thing fishy in their stomachs. Upon clearing the stomach from its contents, the interior mucous coat came away with the gentlest touch, probably, because it had been

now three days after he had been taken ; near the stomach in the left and anterior part internally I observ'd a vast many holes and mouths, and I reckon'd about 50 of them ; some of them were round, some like a half moon, many of them furnish'd at their extremity with a white ring or border, and some of them were inserted obliquely : Whence, while entire, they with more difficulty admitted a probe, nor could any thing from the stomach enter these canals ; for, upon pressing externally the whole of them, only a whitish or grey and somewhat turbid *mucus*, smelling of castor, very plentifully ouzed out. Upon cutting one or two mouths internally in the stomach, there soon appear'd four, five, and more holes ending in that mouth ; and thro' the mouth I could thrust the probe without any resistance, as far as the blind extremity of the canal : I cut lengthwise several of these canals to their extremities ; internally they were full of *mucus*, disposed like honey in combs, in wiping which off, a somewhat rough surface like velvet appear'd, and I also observ'd their internal surface spread over with capillary vessels : The coat of the canals is, indeed, thin, but not so easily torn ; a muscular membrane externally involving the canals seems to compress them, and upon occasion to force the *mucus*, generated in them, into the cavity of the stomach, and protrude it with some violence : The bottom, or part of the stomach to which they grew, and their roots resembled a kind of mushrooms, the small holes no longer observing that exact order, which was to be seen in the blind extremities, on account of the various, and for the most part oblique insertion of the canals into larger *tubuli* ; and most of them still plentifully discharg'd a turbid *mucus*, lightly tinged with the blood from the wounded capillary vessels, tho' by repeated squeezing, all the juice, lodg'd in them, seem'd to be exhausted. The gullet, as more fleshy than the intestines, seem'd a fistulous muscle, chiefly on account of its exterior coat ; the internal coat, where it terminated in the stomach, jutted out, and constituted a border, from which hung round about small white *apiculi*, like those observable in a boil'd ox's tongue. In a part of the gullet, more remote from the border, I observ'd many such hanging down from the internal coat, which seem'd to facilitate the ingress into the stomach, but to prevent a regrefs : I did not find this internal coat continu'd with the stomach, as I could separate it without tearing the membranes of the stomach. In the *pylorus* the nervous coat of the stomach jutted out, and form'd a border, or ring, or circular valve, which seem'd to admit an egress, but to hinder a regrefs, or render it difficult ; it was also thicker, denser, rugous, and furnish'd with streight furrows, as if the *pylorus* also perform'd the office of a sphincter : Before the *pylorus* in the *duodenum* I observ'd a *sinus*, wherein, on account of the ring of the *pylorus*, the matter regurgitating upwards might have there stagnated. The thin guts were upwards of eight ells in length : The *colon* and *rectum* made two ells : The *cæcum* also in the left side adhering to the *colon*, was very large ;

nay,

nay, wider than it, terminating in a narrow point. The *colon* was beautifully divided into cells, strengthen'd by a white nervous line; it contain'd softer *faeces*, but the *rectum*, harder. The excrements consisted of segments without any *faetor*; after taking out and washing a portion of the *ileum*, the *cæcum*, *colon* and *rectum*, I caus'd inflate them, and dry them in the shade: After cutting the *ileum*, as far as the middle of the *colon*; in the beginning of the *colon* I first cut thro' a valve, fasten'd to the *ileum*, nervous, circular and hindering a regress into the *ileum*; and then thro' a very large cavity or space, in which not far from the mouth of the *ileum* in the left side was a very wide orifice opening into the *cæcum*, which had a remarkable nervous valve, externally regarding the cavity, and stopping the larger and impetuous ingress of the *faeces*; in its inferior part on the right side appear'd another aperture, terminating in the *colon*, in which was also situated a nervous circular valve, inclining downwards, and giving a descent to the *faeces*: And in fine, I observ'd as many nervous and membranous valves in the *colon*, as there were cells, and all of them semilunar; and generally the two opposite valves form'd a circle: Some, indeed, were not directly opposite, but not at so great a distance as to hinder their forming a circle; because the inflation was made thro' the *rectum*, the valves of the *colon* were rais'd higher. The *rectum* in the *pelvis* was very large, to which externally on all hands adher'd a muscle with streight fibres, three inches in length, arising from the *os pubis*, on the sides of the *os ilium* and *sacrum*, strong, as being the *levator ani*, which ought to be strong, and quite encompass this intestine for retracting the *anus*, probably thrust out farther in discharging very hard excrements: Under this muscle, near the *anus*, was a *sphincter* with muscular fibres: The exterior coat of the *rectum* had very strong, streight fibres; so that equally with the gullet I may venture to call it a fistulous muscle; but the internal coat was very rugous and plaited; and by the gentlest touch separated from the next external coat, and it is that very coat, which in a *proidentia ani* seems to jut out, and when mortified may even in a man be cut away without danger; and when swell'd, it is often the cause of a more difficult and very painful discharge. The spleen was very small, three inches in length, a small finger in breadth, and very slender, scarcely of the thickness of the back of an ordinary knife, of a pale red, soft, and seem'd rather a fillet, sew'd, as it were, to the stomach: The liver was soft, ruddy, large in proportion to the bulk of the animal, and divided, as in the former beaver, into lobes: The gall-bladder, not answering to the bulk of the liver, was small, and half full of a liquid gall: The *ductus bilarius* extended an inch without the liver. In the skin of the *pubis* were observ'd two remarkable apertures; above, under the *os pubis* is the *rima*; below, under the tail the *anus*: Between these apertures on each side in the smooth skin appear'd two holes, which admitted a probe, but not deep, from which some stiff and blackish hairs grew

out an inch in length: In the upper part of the *rima* is lodg'd the *penis*; under it, the *rima* is by means of a partition-membrane divided into two parts, each of which terminates in the lateral *sinus*. Upon removing the skin in the *inguen*, only leaving the lateral holes and the inferior part of the *rima*, where the membrane was divided, there came to view vesicles full of an unctuous liquor, the castor-bag, the testicles and *penis* situated without the *abdomen*.

The vesicle or follicle, and the *castoreum* or castor-bag, properly and truly so call'd, were cover'd on each side with one common, fibrous, and, as it were, muscular membrane; this membrane arose under the *os pubis*, and envelop'd both bodies, and was lost under the vesicle or follicle; it was furnish'd with streight and oblique fibres; from its origin and insertion it did not seem to be a portion of the *panniculus carnosus*, but a peculiar membranous muscle, serving not only as a cover for these parts, but also for compressing them. Upon removing on each side the fat, and this muscular membrane, the testicles, included in the processes of the *peritoneum*, the castor-bag and the vesicle, to wit, three distinct parts on each side, came more distinctly to view. The vesicle and castor-bag were manifestly distinguish'd; for, each part was still invested with a thin membrane, over which a great many capillary blood-vessels were spread, proceeding from the neighbouring hypogastric and iliac vessels. In figure the vesicle is like an almond, cover'd with a green rind, two inches long, one broad, and half an inch thick, of a whitish red, its external surface somewhat rough. Upon removing the thin membrane its whole surface was incrusted with several minute, conglomerate glands, cohering by very fine fibrils, upon separating which, the whole surface seem'd possess'd, as it were, of whitish red warts: These verrucal glands, as I may call them, adher'd very strongly to the membrane of the bladder, as warts do to the skin; several capillary vessels crept between these warts, each of which might also be divided, without tearing, into other very minute glands, with capillary vessels also appearing in their interstices. Near the neck of the vesicle or follicle, at its lowest part was a gland, of the bigness of a kidney-bean, which at first sight was globose; upon compressing it, there came out of the lower hole a white substance like a maggot, of the consistence of new cheese, and of the thickness of a pigeon-quill, tho' the hole appear'd not much bigger than the *punctum lachrymale*, and it smell'd of castor: Upon squeezing the vesicle, there came out of an adjoining hole a yellow, oily liquor, of a strong scent of castor, nay, of rotten cheese: Both these holes are situated in the intermediate space between the *rima* and *anus*; each of these vesicles contain'd a drachm and a half of an oily liquor, with which something cheesy was mixt: The liquor, receiv'd in a vessel, soon concreted like congeal'd oil; a paper, done over with it, and approach'd to the fire, made a crackling noise long before it flam'd, as if there

there had been much water or salt mingl'd with it; but after consuming what was less inflammable, it burnt more clearly than bare paper does. Upon cutting a small hole into the vesicle, and blowing it, it swell'd very much, without the wind escaping at the natural aperture: On the surface of the inflated vesicle, the verrucal glands became more separated, yet not inflated by the wind, nor did there happen the least change in the adjoining castor-bag. I afterwards cut the whole vesicle lengthwise, and after clearing it internally of its contain'd liquor, it was found encompass'd quite round with a thin membrane like an *amnion*, rugous and plaited, which could not be owing to the inflation; for, I found the like membrane in the opposite vesicle, into which I had not blown; there also appear'd several very minute mouths, some of which admitted a millet seed; some a lentil, and a middling probe. Upon externally compressing the verrucal glands, from most of the mouths there burst out into the cavity of the bladder a yellow oily liquor, and from some of them also a cheefy substance; for, each gland had one mouth, and sometimes two beneath; there also appear'd internally thro' the thin membrane a great many capillary blood-vessels; besides, the internal surface, on account of the roots of the glands, was very unequal: The neck of the vesicle internally was narrow and rugous, furnish'd with streight furrows, which externally for some way easily admitted a probe, but being internally streight the passage was more difficult. The globose gland, adjoining to the neck of this vesicle, and of the bigness of a kidney-bean, after clearing it of its contents, appear'd also of the conglomerate kind. After viewing these things thoroughly, I took out the vesicle, without hurting the castor-bag, and this I could easily do, as they were distinguish'd by their proper membranes, and the neck of the vesicle had a peculiar egress, terminating in the smooth skin with an aperture half an inch distant from the *rima*: Upon inverting the vesicle, and stretching it upon my finger, there appear'd orifices like little cups, encompass'd with a membranous border, from which orifices, upon pressing the verrucal glands, there still came an oleaginous, and from some of them also a cheefy liquor.

The *castoreum*, or castor-bag, lay on the superior part of the vesicle; at first sight it appear'd to be a glandulous body, of the conglomerate kind, three inches long, one and a half broad where broadest, at its extremities an inch broad, and where thickest scarce an inch thick; in figure it resembled an oblong dry pear, round in its anterior, but flat in its posterior part; its surface might be compar'd to the winding surface of the brain, its colour was grey, intermixt with red veins; a nervous membrane, furnish'd with a great many capillary blood-vessels, cover'd the surface of the *castoreum*; this membrane I could easily separate in a fresh, but with more difficulty, in a dry *castoreum*, and that not before it was macerated in water: In separating it I found, that it not only join'd together the windings on
it

it by means of very tender fibres, but likewise cover'd those windings every where even in the deepest furrows. Upon expanding and laying open these windings and *gyri* by breaking the fibres with my finger, I observ'd remarkable and numerous capillary vessels creeping among the deeper furrows: After removing the nervous membrane, there appear'd another very beautiful one, furnish'd with several very minute scales as it were, which oppos'd to the light, shone like silver, especially when they were rais'd and separated; but when they lay flat, appear'd livid, nay, according to the different incidence of the light, yielded different colours like a pigeon's neck. This membrane was every where moisten'd by a very thin and limpid liquor. In the *rima* was an orifice into which one's finger might enter, opening into the cavity of the *castoreum*; upon putting in, therefore, my finger, I could expand all the windings or *rugæ*, and by blowing into it they were more expanded, and the whole *castoreum* in all respects resembled a bladder: And thus I evidently learn'd, that the *castoreum*, which before I had taken for a glandulous body, was nothing other than a bladder, or a rugous and plaited purse, and form'd into various windings and *gyri* by its exterior nervous membrane: When expanded in this manner by inflation, it might hold four ounces, but otherwise, tho' indeed it had a cavity, scarce two or three drachms. Upon cutting it up, in its cavity was contain'd a waxy substance, as it were, yellowish, friable, of a strong and sharp odour, divided into little bits, some of which were as big as a pea, others bigger; its internal surface was beset with the same substance, and its *paries* seem'd as if tinged with ochre; internally also the membrane was squamous, whence that yellowish substance stuck out, but it adher'd firmly to the scales or *villi*, so as not to be separated without pulling away these *villi*: And upon pulling these out, there were punctures left in the membrane like the prick of a needle: It manifestly appear'd, that that waxy substance took its rise and increase from atoms, or very minute particles incrusting the *paries*, and separated by attrition. The same *phenomena*, as above, were observable in the other *castoreum*. I also found, that the vesicle and *castoreum* on each side may, on account of the skin, by means of which they cohere, be so separated, as from one beginning to remain connected, the skin doing the office of a ligament or intermediate tie; but that the two follicles of both sides could by no means be included in one membrane: The weight of the two *castorea* with the two vesicles was scarce four ounces.

I found the testicles in this beaver, contrary to my expectation, under the *os pubis*, included in the *tunica vaginalis* near the *castoreum*; externally no signs of a *scrotum*, or testicles in the *inguen* were discoverable either by the sight or touch; and tho' the testicles were near the *castoreum*, yet there was no communication between them and the *castoreum*, either mediate or immediate. The blood-vessels, both the *deferentia* and the capillary vessels in their surface, appear'd plainly thro' the *tunica vaginalis*, or the process

process of the *peritonæum*. The testicles being gently press'd retir'd into the cavity of the *abdomen*, and lodg'd in a *sinus* form'd internally in the *peritonæum* above the *os pubis*; above were inserted into the testicles the *vasa deferentia*, commonly call'd the *pyramidalia*, forming on all sides with each other surprising *anastomoses*; on them lay the *epididymides* and *parastatæ*: Into the external part of the testicles, into the *parastatæ*, were inserted, by means of a thin membrane, the *cremasters*, in proportion to their small bulk, remarkable and half hollow, with a membrane enveloping their nervous tendons, as if these muscles, which were pretty strong, were to serve for the retraction of the testicles within the *abdomen*: The testicles were very small, very white, thick, oblong, and less than pigeon-eggs, and fresh they both weigh'd four scruples, but dry, exactly resembl'd grape-stone, shrivell'd up and dingy, and then they weigh'd only twelve grains, and seem'd nothing other than a wrinkl'd skin; and neither fresh or dry did they smell of castor; nay, were insipid and inodorous, and could be adulterated by no art, because the cheat might soon be discover'd by one who has once but transiently seen a beaver's testicle. Upon carefully loosening the small branches of the *epididymides*, *parastatæ*, and *vasa ejaculatoria*, I observ'd under the *os pubis* one continu'd duct, of an equal bigness, straight, round and nervous, and under that bone it proceeded to the neck of the bladder, but behind the bladder it became four times thicker, and as big as a goose-quill, but not so hard and solid: They were inserted on each side laterally into the neck of the bladder. In order to view this more accurately, I caus'd inflate the bladder by the *urethra*; and the bladder became greatly swell'd and globose: A portion of the *urethra* for an inch from the internal orifice, before it came under the *penis*, was distended as big as one's thumb; but the *urethra*, conjoin'd with the *penis*, was in no wise of this bulk; and that bigger portion we may call the neck: They were, therefore, inserted laterally into the neck, at an inch distance from the internal orifice. In the middle, between the insertion of the *vasa ejaculatoria*, were inserted the *prostatæ*, whose appearance was surprising; for, about their insertion, half an inch in breadth, they are expanded into two long horns towards the *vasa ejaculatoria*, resembling a cowl, white and soft; under the neck they are of the thickness of an ordinary quill, at the extremity more slender, to which on each side adher'd a pellucid gland, of the bigness of a hemp-seed: Between the *cornua* of the *prostatæ*, and the *vasa ejaculatoria* was situated on each hand a plaited body, compos'd of vesicles and glands, whitish, and adorn'd with capillary blood-vessels: I took them for the *vesiculæ seminales*. Upon cutting this neck of the bladder forwards, I observ'd internally in the posterior inferior part a prominent caruncle of the bigness of a pea, so as to have a *sinus* beneath, into which a catheter being thrust may easily reach: In the middle of the caruncle above, there appear'd an aperture, and two others laterally, to wit, one

on each side. Upon pressing the *vasa ejaculatoria* from their lateral aperture, came out a white, thickish *semen*; but upon squeezing the *vesiculæ seminales* not so much as a drop. Upon squeezing the *prostatæ*, either both or only one of the horns, from the middle aperture was discharged a thin, yellowish, turbid liquor. Upon cutting lengthwise the *vasa ejaculatoria*, they were found hollow, containing still a white concocted *semen*. Upon opening the *prostatæ*, each horn had an oblong deep furrow, which united together before their insertion, but upon cutting the *vesiculæ* lengthwise and a-cross, I observ'd nothing besides a thin *lympba*, at least nothing like the *semen* of the *vasa ejaculatoria*.

The kidneys were less convex than in other animals, flat and compress'd, and sharp at their borders, two inches and a half long, and one and a half broad, and where thickest scarce an inch thick. Upon opening the *pelvis* I observ'd its surface finely drawn over with capillary vessels; the caruncles, of a dark red and large, jutted out from the canals. Upon compressing the *pelvis* towards the *ureters*, streight long furrows were observ'd in them; the *ureters* were strong and nervous. Between the duplicature of the bladder they proceeded above an inch before they opened into the bladder, and that obliquely. The bladder was almost empty, containing a little turbid urine, was thick, rugous, and furnish'd with streight plaitts, and of the bigness of an ordinary pear. Upon inflating it, it became remarkably big. The emulgent vessels, such as the veins and arteries, were large. In the *pelvis* at the sides of the *rectum* and bladder I found two oval glands, of the bigness of a hazel-nut, pulpy and containing a viscid *mucus*, in their circumference porous, as if they had been prick'd by a needle. These glands probably impart this *mucus* to the *rectum*, of which it has always plenty. The *penis* was lodged in a peculiar and superior *sinus* of the *rima*; the whitish, rugous *glans* was cover'd with a white and rugous *præputium*, having below a *frænum*: From the *urethra* hung down two small plaitted bodies, of a dark red, like the *nymphæ* in women; its bony anterior part for an inch in length is cover'd with a loose, rugous skin, furnish'd with streight furrows, roughish and sprinkled with several black spots, arranged in a certain order; its posterior part was soft, compos'd of two spongy bodies and the *urethra*. These bodies were cover'd with a hard, nervous membrane, arose from the *os pubis* in a broad nervous circle, internally of a dark red: These bodies were in all respects as they are describ'd by *Arantius*, to wit, like the pith of a reed; the one was distinguish'd from the other by a nervous partition. About the root of the *penis* I found remarkable blood-vessels, which for some way extended towards its sides and enter'd the spongy bodies; there also I found the *levatoris penis*; the officle of the *penis* was firm and hard, white, nowise cartilaginous, anteriorly globose.

In the head were also observ'd some things worthy of remark: The temporal muscle was thick and very strong, and for that reason the *os jugale* was arch'd, a portion of it jutting out: The *sinus* for receiving the *apophysis* of the inferior *maxilla* was half an inch distant from the *occiput*, whence it might also yield backwards, otherwise than in a man. In the lowest part of the orbit of the eye were three eminencies, in which the roots of the *molares* terminated, and near these eminencies the optic nerves proceeded: The *molares* were 16 in number; in each side of the upper and lower jaws four; the situation of the inferior *molares* inclin'd obliquely forwards; of the superior, obliquely backwards: In the upper jaw the posterior did not touch the two hinder inferior: In the inferior jaw the anterior did not touch the two superior. Between the *incisors* and *molares* I found a space, of an inch in length, without teeth. The incisors in the upper jaw are shorter, paler and of a yellow colour; the inferior are longer and red; both of them broad and equally sharp: The inferior enter into the superior, but do not touch each others points: Whence in the superior *incisors* is form'd a sinus for receiving the inferior, which is also seen in some birds of prey, as the eagle, the hawk, and even the parrot. Hence the skull of the beaver, stript of its flesh, did about the mouth resemble, as it were, the beak of these birds. In the palate, not far from the *incisors*, were two holes, of half an inch. The canal of the ears was directed upwards; where it ceas'd to be bony, the *tympanum* was seen. I observ'd a wonderful variety of sutures; the sagittal suture extended to the nose, the coronal reach'd to those two oblong holes of the *os palati* before the orbit of the eyes; and besides these, many others were observable. The bones of the *cranium* were close and strong, and of an ordinary thickness; the tongue was very thick and fill'd the whole mouth. Each eye had seven muscles.

Maximilianus Henricus Egermejerus inform'd me, that in a beaver he dissected, after cutting away the *castereum* and *follicle*, he observ'd about the stomach that ruddy eminence I observ'd above, and upon removing the thin nervous membrane and the thicker ruddy one, he saw the blind extremities of the *tubuli*, arranged in a beautiful order, like conglomerate glands; that upon opening the stomach thro' several both greater and smaller mouths, and after externally compressing it in that eminence, there was discharged a white and grey, clammy *mucus*, smelling of castor and pretty saltish; that the mouths scarcely admitted a probe internally, but externally upon making a wound on the top of the *tubuli*, the probe pass'd without any obstacle thro' the *tubuli* into the cavity of the stomach; and that he also observ'd a very large *cæcum*, stuff'd with excrements.

It is a groundless report, that the beaver, when pursu'd by the hunters, Observationa bites off his genital parts, as *Pliny*^a relates the story, and that according

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^a Hist. Nat. lib. 8. c. 39.

to *Solinus*^b, they swallow them; that this was a fabulous relation, the ancients, as *Dioscorides*^c, to whom *Pliny* agrees^d, have long ago observ'd, and many also of the moderns have done the same thing, as *Phil. Jac. Sachs à Leuwenheim* in his *Gammalogia*^e: But the history of the two beavers above does abundantly show, that the cutting away these parts, if not impossible, would yet be always dangerous, and that thereby they would be so far from saving their lives, that they would hasten their death; as they must not only bite off the testicles, but also the castor-bags with the follicles, which could not happen without a plentiful hemorrhage, on account of the wide base of those parts and the remarkable blood-vessels lodged in them; and which would be the more fatal, as the blood of beavers is very fluid. Tho' it is not to be denied, but that in brutes these parts may be cut away without hazard: And some of these operators, performing on men, oblige them to walk about soon after the operation, and that without any danger; and they affirm that they venture to do this from using a certain excellent, foreign balsam, which they, immediately after cutting, pour into the fresh wound; and I very lately learn'd of a surgeon, who assisted in these operations, that this balsam is nothing other than melted hogs-lard, which they plentifully pour into the fresh wound. The story of the castor's biting away his testicles, is probably owing to huntsmen themselves, who first contriv'd this fable, either as they observ'd the beavers, tir'd with the chace, licking their groin, or as they themselves privately stole the castor-bag, as a thing of value, and so put upon their masters by this ridiculous tale.

Both the beavers above had the *testes* of a male, as well those I found within the *abdomen* in the first, as those I found externally under the *os pubis* in the second, as appears fully from their description.

The *castoreum* or castor-bag is falsely call'd the testicles, and such as assert it are deservedly reprehended by *Charas*^f; which also *Rondeletius in Gesner de castor.* has long ago affirm'd, because there appear'd to him no passage to the *penis*; and besides, the dissection of both the beavers shews, that neither the castor-bag nor the follicles contribute any thing to generation; and therefore deserve not that name. They are, indeed, both call'd *castorea* by *Dioscorides l. c.* and *testiculi* by other physicians, but absurdly, according to *Melchior Sebizius*, in his treatise de *Aliment. facult.*^g where there are more arguments to evince, that the *castoreum* deserves not the name of testicles; and of this opinion also is *Jan Saracen. in Not. ad Dioscoridem.*

Our *castoreum* is the true *castoreum* of the ancients, which we may not only safely use for removing those diseases, in which they write it was of service, but may mix it with the *theriaca*; because, if we are to abide by the

^b cap. 23.

^c lib. 2. cap. 23.

^d lib. 32. cap. 3.

^e lib. 1. cap. 2. § 3. p. 19

^f *Hist. Animal. plant. & mineral. theriacam ingredientium in Journ. des Sçav. Tom. IV an. 1668. vers. Lat. p. 1-2. exc. Frid. Nitzschii.*

^g lib. 3. cap. 16. p. 1044.

the authority of the ancients, all the principal characters deliver'd by *Dioscorides*, are found in our *castoreum*.

Of what service the waxy substance, contain'd in the castor-bag, and the liquor in the follicle, may be of to the beaver, I own is obscure and uncertain. *Rondeletius in Gesner* relates, that beavers often lick and suck those parts; a thing which is credible; for, the *mucus* in the *tubuli* of the stomach smells of castor, not that it enters the mouths of the *tubuli*, as it is taken down, but because the *mucus* mixt with the chyle, infects the whole mass of blood, from which it is again separated in these *tubuli*: Whence *Gesner* and *Sebizius l. c.* write, that its flesh is unsavory and hard, and that it must be temper'd by boiling before it can be taken as food.

That both beavers fed on nothing but bark, the contents of the stomach show'd, nay, huntsmen agree in this. The illustrious Count *de Furstenberg* at *Wirtemberg* lately caus'd bring up two young ones, but they rather chose to die with hunger, than eat either fish or flesh. The *tubuli* near the stomach opening into the ventricle, and bedewing it with that *mucus* above mentioned, deserves further enquiry.

The virtues of castor are greatly, and often not without reason, cried up in cold affections of the brain, its *appendices* and nerves, to which *Dr. Willis* deservedly reckons hysteric fits; and probably this virtue of the castor in these disorders is owing to a volatile salt; whence it can penetrate into the inmost parts, incide, dissolve and dissipate.

A Dissertation on the Philosopher's Stone, prefix'd by Henfing to his Demonstrationes Chemicæ Publicæ, at Giesſa, Nov. 1722. From the Opus Mago-Cabbalisticum & Theosophicum of Geo. von Melling. p. 517.

Translated from the HIGH-DUTCH.

FROM time immemorial, indeed, a great deal has been writ on the philosopher's stone, as appears from the writings of *Olaus Borrichius* against *Urſinus*, *Kircher* and *Conringius*: And a blind eagerness after it has prevail'd almost so universally, that within these few years between 8 and 10000 books have been wrote upon the subject. And if a man take but the least survey of ancient and modern times, he shall find, that many Emperors, Kings, Princes, Nobles, and others, both learned and unlearned, down to the meanest mechanic, have and still do apply themselves to the stone; nay, the thing is become so common that the meanest dabbler in chemistry can reason about it. On the contrary, there are many who regard the stone as a mere chimera and as a vain attempt, so as not only to oppose it by reasoning, but to look on such people as fools, who would only maintain the possibility thereof. Hence among others Cardinal

The philosopher's stone attempted in all ages.

Parronius says; ‘such are poor weak heads, indeed, who are employ’d about the quadrature of the circle, the *perpetuum mobile* and the *philosopher’s stone*.’

And yet it is remarkable that there are not a few, who make scruple openly to allow of the *stone*, and on that account defame both the art and the artists; and this notwithstanding, apply themselves privately to the making of gold: A remarkable instance of this we have in the Lord *Bacon*, who up and down in his writings is very severe on chemistry; and yet in private he applied himself with great earnestness to this valuable art.

It is certain, that formerly in *France* alchemy was prohibited under severe penalties; and yet the present *Regent* insisted on it, that such members of the *Royal Academy*, as cultivated chemistry, should apply themselves to the discovery of the *philosopher’s stone*: And no one is ignorant, that among *Roman Catholics* the art was forbid upon severe penalties; and yet no where were greater pains taken about it, than in the cloisters themselves.

The author’s design.

In such circumstances it very easily happen’d, that men run into extremes; either they judg’d too favourably of the matter and became too credulous, or blindly despis’d the whole, and contrary to all reason expos’d it: Now as such a procedure ill becomes a man of understanding, I have thought proper on this occasion to say so much of this noted *stone* of the philosophers, that my readers may have a right conception thereof, and be able to avoid every disaster.

I shall on this occasion briefly illustrate the following particulars; 1. What the *philosopher’s stone* is; whether the doing of it be possible, and whether the virtues ascrib’d to it be credible? 2. Why so few have attain’d thereto? 3. The absurd and injudicious *encheireses*, which those in pursuit of the *stone* commonly undertake. 4. Whether it be adviseable for any one to engage in this art?

Definition of the philosopher’s stone.

That we may not reason like a blind man about colours, we must in the first place have a clear conception of what the *philosopher’s stone* properly and truly is: And I define it, *a body compos’d by art from a highly purified, animated mercury and a living gold, and by means of a long continued fire so firmly knit together, as never after to be separated; in which form it can in an instant so ripen the other metals, purify and fix them, as to become exalted to the nature of the purest gold.* That the whole may be rightly understood, I shall take this definition to pieces, and explain in particular all the parts thereof.

Explanation.

In the first place I say, that the *philosopher’s stone* is a *body compos’d by art*: This art, indeed, is now a days call’d *chrysopæia*, but abusively: ‘for, we make no gold, says *Geber*, but we only supply nature with the preparation of her own proper materials, that she may compleat the design of the greatest purity’. Others call the art *alchemy*, but improperly too; for, this art is rather employ’d about the resolution of natural bodies

bodies, and has many views and many purposes: On the contrary, the principles or fundamental rules of our art are aptly call'd *philosophia Hermetica*; the art itself, *Ars Hermetica*; and the artists themselves, who have actually compleated the *stone*, are call'd *philosophi adepti*, or only, and that by way of eminence, *philosophi*: And such have no further work on their hands, than to purify and unite; and they deal in nothing other than the centre or soul of mercury and gold: The production itself at last is a wonderful body, *a house of light, the most fixt and inconsumable, in fire the most fluxile sulphur of nature*; and in fine, *the seed of gold, a medicine for men and metals*. Such as give out, that they have seen this stone, as *Frederic Gallus* in his journey to the desert *St. Michael*, affirm, that in the night it is shining bright, but in the day time, a transparent, blood-red stone, or also a powder: Others assert, that it is also very heavy, and that it must be so, appears from the parts of which this stone is compos'd; for, I have said, that its constituent parts are a highly purified, animated mercury, and a living gold. These things we must consider a little more exactly.

First, there is mention made of a mercury: Here in general we are to observe, that it is a very ancient saying, *in mercury is all what the wise look for*. Now when we ask in particular, what sort of mercury it is, and wherein it is to be sought, and proximately to be found? The philosophers in their writings make such surprising and round about descriptions, as entirely to confound the reader: But does a man enquire with indefatigable labour into the agreement of the philosophers and follow nature, he finds the following truths, which to avoid prolixness, I shall couch in these short axioms. 1. The only design and effect of the *philosopher's stone* is the increase and generation of gold. 2. All increase and generation of a species are brought about by a similar species, that is, a like generates its like; thus a lion begets a lion, and not an elephant; a man, a man, and not a bear, &c. barley yields no wheat; nor does corn yield any rape-seed. 3. Every thing, that is capable of increase, must have its proper seed; and each seed requires its own proper fit matrix, if otherwise we design the seed shall not be spoil'd, nor, contrary to the nature of the thing, yield a false production. On this account no husbandman is so absurd, as to sow his grain on marble, or throw his barley into a marshy meer, but he carefully prepares his field, and commits the grain thereto; and who shall reckon that husbandman prudent, who has sown poppy-seed, and would reap wheat? 4. Every seed, shall it otherwise be fruitful, must above all other things be entire and sound, as to its structure and mixture; and then both its external and internal parts must be relax'd by a proper moisture and be made fluid; besides this, a proportional warmth must set the solution a going, that is, bring it to perfect action and move the whole: Besides, the air must have access to it in a due proportion, that the warmth may

may not be stiff'd, and the solution and circulation of the juices be not impeded. Upon these accounts corn grows not green upon a dry bottom; no barley blooms in winter; and under the earth or in an air-pump we are to expect no fruit. 5. The moisture, which nourishes the seed, gives it no particular specification, but it is specificated in and by the seed; and this moisture must have in itself the material principles, of which the seed consists, namely a nitrous, fatty substance: Whence common salt water or vitriolic, aluminous water destroys the plant. 6. The seeds of the vegetable and animal kingdoms cannot yield the fruits, one of the other: As oats cannot produce a rabbit; and from the seed of a fox no pear-tree can be produced. Now as the vegetable and animal kingdoms have each of them their peculiar seeds, *matrix*'s, manner of generation, and life; and as out of its own species none of them arises and consists, so is also the mineral kingdom very different: When, therefore, in this kingdom mention is made of seeds, life, death, growth, increase, *matrix*, moisture, warmth, air and the like, we are to understand all these things according to the species and nature of minerals.

Now do the hermetic philosophers secundarily seek for the increase of gold, they must 1. have a gold-feed; 2. a proper liquor, 3. fit *matrix*'s or soils. Now to discover these things we shall again run over these short rules. 1. Gold according to its qualities is the most fixt, pure and heavy substance in the three kingdoms; according to its substance, a body coagulated together from the purest and most fixt mercury, sulphur and salt; so that these its principles, except the third, cannot be separated from each other, either by art or nature.

As according to the order of nature, the seed must be of a like substance with the fruit, as we have said; so according to the opinion of the genuine philosophers it is true, that the seed of gold must not be sought for in consumable, volatile, vegetable and animal substances, nor in sulphureous, arsenical things, &c. but in gold itself. 2. But gold, so soon as it is smelted out of its ore, is dead, that is, can of itself yield no increase, in regard it only has so much moisture in itself as is necessary to its essence, as we have said above of corn. 3. To make it, therefore, into a living seed, its essential moisture must be unlock'd and augmented with its like. 4. Now its essential moisture is mercury, which is coagulated by its sulphur, and is shut up in stony bands or receptacles, as appears from the first rule. 5. The solvent of gold must also be a mercury. 6. This mercury must be sought for in the mineral kingdom, and, exclusive of the vegetable and animal kingdoms, nay all elements, must be found therein.

But that in this search we may not go astray, I shall again draw some certain axioms from the true philosophers. 1. Our solvent and our water, say they, is a metallic, ponderous, shining bright and dry liquor, that wets not the hand. 2. Further, our water has a near affinity with metals;
it,

it, therefore, mixes exactly with them and quits them not readily. 3. Our water, after its preparation, goes off entirely therefrom in the fire, as a volatile spirit, or remains entirely fixt therein. 4. Our water, united in a proper quantity with gold and silver, makes them volatile; and also with them abides the fire: And upon viewing all nature around we find no liquor, which has the above qualities for the most part and even in its crude state, like quicksilver or common mercury: But now the confusion continues, in regard all do reject the common mercury, and hence some would have a mercury of bodies, that is, of metals from gold and silver; but others from all the elements, by which means many millions have been squander'd away. But that this confusion may be of no prejudice to us, I shall again cull out these short axioms of the philosophers. 1. The excellent author of the *arcanum philosophiæ hermeticæ* confirms Geber's opinion, when he says, ' he, who regards common mercury, as it exists in nature ' and in its entire substance, for the radical solvent of gold, deceives both ' himself and others: But he, who, on the contrary, entirely rejects the ' mercury of the vulgar, acts against the truth.' 2. He, who can draw from mercury its purest substance and free it from its leprosy and dropsy, is in the highest road to find out our mercury. 3. He, who can increase in due weight the innate internal sulphur of mercury, has then at length the true method to separate the true water and *menstruum*, the sulphur and mercury of gold from the hard, close, rocky shells, and to render it living or active.

This is that valuable water, which has so many names given it by the philosophers for the insnaring the imprudent; and which I have openly and without reserve (so far as I could discover it from upwards of 400 books after indefatigable study and experiments) call'd above in the definition, *a highly purified, animated quicksilver*.

We shall now also consider the *living gold*. Common gold, as was already said, is entirely passive and dead, as it were; besides, it has partly inherent foreign impurities, and partly different things are added to it by artists both in the mint and other works, which lessen its natural worth and uncommon beauty: Hence the philosophers reject, indeed, the common gold, tho' not gold itself; but they teach to purify and cleanse it from all alloy by means of the corroding, mineral *wolf*, antimony, or by quartation, solutions and precipitations, cementations, &c. and then they look upon it as the proximate matter, from which the sulphur of the philosophers must previously be made, before the *stone* or the true gold-seed can be set at liberty; namely, with a drachm of the purified gold, made into a subtile powder, and with three drachms of the above philosophical mercury, they make the softest amalgam, that is, a mass, which like soft butter suffers itself to be treated by the hands. This they put into a proportionate glass-phial, call'd the external *philosophical egg*; and even it is such,
and

and effects, according to its nature, what the shell of an animal egg does; then they shut close the phial above, that no more air may come in or go out than is needful; and then they give it in a spacious furnace the due degree of warmth, incessantly day and night for nine months together; and in that time the gold with the mercury is volatile, and as the philosophers speak, it is reduced to its *first matter*. In the mean time there appear from black to white, from white to red so many wonderful colours; consequently, so many different circumstances of the copulated mercury and gold, as the philosophers cannot sufficiently describe; till at length the gold gets the upper hand, and thus unites the mercury with itself, so as never after to be separated therefrom by any force of fire, water or air. Now this is the first rotation: But yet the stone is far from being made; but first the sulphur of the philosophers is form'd, which yet effects nothing other than that it farther quickens the dead gold, makes it rich in blood, nay, in seed; for, when this sulphur is mix'd with gold, and then the mercury of the philosophers is put to it, and as the first time it undergoes a coction of 7 to 9 months, so at length is obtain'd the so highly priz'd stone of the *wife* in the true seed of the gold, which suffers itself to multiply into several millions: And thus we see the soil wherein this seed is set.

A common soil for vegetables must have a sufficient quantity of water, and a fat, saline, hollow earth, when it is to be fit for the purpose, and this water, fat and salt will be in the corn increas'd to corn, in wheat to wheat, &c. These same principles smell well and agreeably in the rose, clove-jelly-flower, lavender and *narcissus*; in black currans they stink like buggs: In hen-bane, *opium* and *assa fatida* they also smell disagreeably: In a word, so many feeds as there are in nature, so many times is the undetermined water and earth determined and specificated. The philosophers also in this manner have their peculiar soils for their gold-feed; and these indeed are very different in goodness, as also usually happens in other common soils; for, sometimes one field wants water; another, fat and salt; another, is too sandy; another, too stony, &c. But there are properly six soils of as many different natures and worth; the first and best is mercury; the second, silver; the third, tin; the fourth, lead; the fifth, antimony; the sixth, and the worst, iron.

Each of these metals has its certain proportion of mineral humidity, that is, of mercury, of mineral fat, that is, of metallic sulphur; and these are sometimes mixt with more, sometimes with less inflammable, earthy, stony, and glassy materials: And hence depends the worth of each metallic soil; and on that account some of them, as tin, lead, copper and iron, must be entirely and peculiarly prepar'd and purified, if you would otherwise expect the golden seed to bring forth a suitable crop in them.

Now

Now, as in the projection, as it is called, or properly in the sowing, one grain of the fermented and multiplied philosophical stone falls on a thousand or ten thousand parts of smelted metal; so the mercury and sulphur of the metals nourish and increase the seed, and at the same time are by the seed specificated to the nature of gold: But all this happens here instantaneously; as 1. This metallic seed is highly pure, active and penetrating; 2. As it has no organical structure, but an union of homogeneous parts; 3. As the whole happens in the fire, whose actions and operations are much quicker than those of air and water: And even in this manner a seed may be prepar'd from silver, which reduces the above-mention'd bodies to its own nature. Lastly, we are to observe in all this, that the way hitherto explain'd is by the philosophers call'd the *dry way*; they have, indeed, also a *humid way*, but it is kept so secret, that no one can be the wiser by their writings, and therefore we shall not meddle with it. It is sufficient, that from what we have said the reader may clearly perceive not only what the *philosopher's stone* is, but that both its preparation is possible and its effects credible.

We, therefore, proceed to enquire into the reasons, why so few have attain'd to the *stone*. To attain to a just knowledge in any science, or art, several circumstances are requisite, 1. An experienced and faithful teacher; 2. A certain length of time; 3. A certain disposition of the understanding and body; 4. Prudent and constant exercise; 5. Proper materials and instruments; 6. A proper place. Where one or other of these circumstances are wanting, no art can be learn'd, at least not to perfection.

Why so few have attain'd to the Philosopher's Stone.

Now let us apply all this to our art. If any art requires deep knowledge, or a peculiar knack or skill, it is certain the hermetic art does so; but where shall we find skilful and faithful teachers to assist us therein? We have books enow, but of what avail are they? First, they are obscure: And again it is rare, that an artist shall qualify himself for his profession by books alone: But the reason, why we have none, or seldom any living master in the hermetic art is, that if any one sets up for an *adept*, he is in danger of losing both his freedom and life. Upon reading the fate of the renown'd *Philaletka* in his *display'd palace*, one may indeed wonder at the wickedness of the world; nay, if a man in the course of his profession venture to treat with understanding and due order of that innocent and noble art, chemistry, there is nothing but persecution upon persecution. But tho' there is no living teacher to be found, yet the studious in the art apply themselves to books, but with no great success, as they bring not along with them the due measure of understanding; for, a disciple of *Hermes* must first of all be a good divine, that he may know so to behave himself towards God and his neighbour, as that the curse may not pursue him; again, he must be an exquisite moralist, that he may in particular bring his affections under, and may not fall into blind desires and inclinations;

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And lastly, he must be a compleat naturalist, and be master of physics in all the branches thereof, know the composition, species, and virtues of all bodies, that he may not be disappointed in his labour; and then he must have a perfect understanding and practice in the whole compass of common chemistry: And from this character of an adept we see, that it is not every one that is qualified for chemistry.

Besides, the disciples in this art allow not themselves the proper time in it; for, after running over one or two authors, they reckon themselves sufficiently qualified; and as they have learned the art in a hurry, with the same precipitancy they attempt on the *philosopher's stone*: Whence one absurdity follows upon the back of another. And such people measure their own understandings too largely, so that they flatter themselves from the dark riddles and contradictions of the philosophers to have hit upon the true meaning, when yet it is not without difficulty, that one shall reach his end even from intelligible books. I shall, at present, mention nothing of the defect in knowledge as to the right matter, the true regimen, and also the proper place; only hint, that the principal cause is the will of God, who has been pleas'd to create gold and silver without corruption, and that in such quantity, that all men, tho' they were ten times more in number, may to the world's end have enough, did not one time covetousness wrap and rend all to one place; again, lavishness waste; and lastly, pride destroy many millions. When I consider this well, I imagine a spirit of giddiness sent abroad among gold-seekers, which persuades them at one time to chuse antimony; at another time nitre; and again something else for the matter of this stone; that thus in their search they always hope and when their hopes are at the highest, they are the most dangerously deceiv'd in, by and through their hopes: But this is the 3d thing we propose to handle. Such as treat the *Hermetic* art contrary to the doctrine of the true Philosophers, were formerly call'd *Sophists*, but at this day *Alchemists*.

The several materials in which the Stone was sought for.

Among these, some of them observ'd, that *mercury* is no ordinary water, but that something extraordinary must be conceal'd therein: And hence they have also attempted on it; and indeed several have endeavour'd to fix it and instantaneously make it into gold and silver. But this scoffer has not only broke their glasses, but their strong iron vessels too, and flown away in fume; treated more gently, it indeed lost its running form, and after a long time became into a powder; but upon the first occasion it again resum'd its form, and remain'd *mercury* as before.

Others indeed believ'd the saying of the philosophers, that *mercury* in its crude and impure state is of no avail: Hence they have thought to purify it with salt, vinegar, lee, and the like; and they have mix'd it with salt, nitre, *sal ammoniac*, and sulphur: Afterwards they have sublim'd it for 10 or 20 times and upwards. But when they would revive it again, it was leprous, and remain'd so; and thus they lost their labour.

It afterwards happen'd, that some more sharp-sighted, were appriz'd, that salts do not enter into the heart of metallic things, and so do not purify the mercury centrally; much less that they could not add the sulphur that was still wanting; they, therefore, fell upon metals and therewith they mix'd, amalgamated, distill'd, sublim'd, boil'd, and roasted the mercury; but the event prov'd vain. As now mercury was thus teaz'd without success, it was dropt, and they applied themselves to metals; and for a long time a mercurial substance, and a running mercury was sought for from gold, silver, lead, tin, and iron; but partly in vain, and partly without any advantage.

After that the soul, or the sulphur of gold in the other metals, was thought to answer, they then fell on cementation, calcination, and solution with *aqua fortis*, *aqua regia*, oil of vitriol, and on volatilization with acid, urinous spirits, and on extracting with *aceta radicata* and the like. They rack'd their brains so with the *purple mantle* of *Basil Valentine*, as it is call'd, that many thousands have been squander'd away and wasted into smoke. As if gold and silver could quit and lay aside their essence, and the other metals yield what they had not! And from this folly arose the particular processes, which have so often ruin'd the undertakers.

Farther, as the philosophers say, that their gold and silver is living and not dead, that it has still its spirit, that it was never in any smelting fire; so the sophists go down into the mines, take out the ore thence, and would with a thousand nets catch the bird of *Hermes*; when, notwithstanding, a course of many dangerous processes, they only obtain an arsenical sublimate, or a sulphureous water, or even a saline powder: And when bigest with hopes, lo! they are most disappointed. And then, as they find that metals and their ores are close shut up, they betake themselves to minerals and salts; and there they suppose the sulphur and mercury of gold lie open: And then we may with wonder observe, how arsenic, antimony, and mercury affect the operators, rewarding them with diseases instead of gold. As common kitchen-salt does in men's bodies the office of an excellent balsam of life, they suppose it may be proper for the philosopher's stone: And as nitre has an extraordinary force in sulphureous mixtures, particularly in gun-powder, they suppose it may here burst open the strong bolted door of nature: And as vitriol is of service in dying, they imagine it to abound with the sulphur and mercury of gold; and all these things are treated with the greatest application and zeal.

The fooleries we have hitherto related are ridiculous enough, but this is not all; there are others more so behind. Man, say they, is a little world in himself; and made up as the great world is, of four elements; and fancy they shall find the treasure there. But as they doubt in what part of man it is to be found, they fall to work on the blood, hair, urine, excrements, bones, marrow, &c.

Hence *Hel Wigh* flatter'd himself, and would persuade the world, that he found it in the essence of spittle, couch'd under *visaliena testæ*, the anagram of *essentia salivæ*. Some affirm, that the earth is the *matrix* that receives the influences of heaven; therefore, that universal spirit, or the *anima mundi*, the *Archæus*, &c. is coagulated therein, and found thus coagulated. They, therefore, dig up *bolus*'s, loamy earths out of fields that were never plough'd; these they expose for some months to the rays of the sun, moon, and stars: At length they elixate these earths or distil them; and at last obtain either nitre or *Dutch salt-petre*.

Others with highly calcin'd salts search for these costly things in the air; and for this they ransack dew, hail, snow, rime, *March* rain-water, and sun-beams to yield the *spiritus mundi*: Yet to no purpose. The artist forces from these things oils, salt, water, and earth; and is as far from his purpose as ever.

These are the greater follies; and I could also mention a great deal about the lesser ones, but that it is time to have done.

Some queries resolved.

There are three queries remain to be clear'd up, *viz.* 1. Whether it is adviseable for any one to engage in the hermetic art? 2. What the qualifications are which a happy disciple of this art must have? 3. How one may know a person who pretends to be master of the art, or who would undertake to teach it? As to the first query; I roundly answer in the negative; for, tho' we are assur'd, that the true principles of the philosopher's stone lie in mercury and gold, yet there are still a great many locks to open: At the least, the philosophers assure us, that the true preparation of the mercury has not been openly, and in particular mention'd by any one; nay, they assure that this preparation cannot be discover'd in any writing under the sanction of the most horrid curse; and when any one arrives to this knowledge, it must either happen by immediate divine inspiration, or by means of the oral tradition and manual demonstration of an adept, under the seal of the greatest secrecy. And after one has obtain'd this philosophical mercury, there are in the after work, on account of the external furnace, the composition, the weight of fixt and volatile gold, so many difficulties remaining, that most people become doubtful, as they have not the patience of *Pontanus*, nor expect to arrive to the age of Count *Trevisan*.

The second query we have resolv'd above. As to the third, to wit, the discovering, whether any one be possess'd of this art, we may ask him the following questions; whether he prepares the whole magistery from mercury alone, or whether he takes gold to it; whether it be necessary to take more than a drachm, or at most half an ounce? 2. Whether with a furnace in a close glass, without opening or moving it, he can calcine, digest, sublime, precipitate, dissolve, and coagulate? Whether the matter in the glass be first black or white? And what is the meaning of this, *viz.* that one must first make silver before he can make gold: And if he can do

o and clear up all this, you may believe him; if not, he is a deceiver. But suppose one has learn'd from books to repeat all this, take heed whether he does not pretend poverty, and then he is no adept; but he will either practise at the expence of your purse, or inveigle you before you are ware. He who is wise will be on his guard!

of Honey-Dews, or Mildews. From the Breslaw Collection. April 1718. Class IV. Art. I. p. 956.

Translated from the HIGH-DUTCH.

AMONG the diseases, with which the fruits of the earth are affected, honey-dew has always been look'd upon as one of the worst. The Romans formerly might be so plagu'd therewith, as to give it a peculiar Deity, call'd *Rubigus*, which indeed by some was call'd *Deus rusticorum*, but was rever'd by the wisest Romans, as among others the learned Varro^a at the beginning of his book *de re rustica* pays his devotion, first to Jupiter and Tellus, then to Sol and Luna, again to Bacchus and Ceres, and lastly also to the God *Rubigus* and *Flora*, which last being propitious, as his words run, 'neither does mildew affect corn and trees, and they blossom in season'. To which purpose also Numa Pompilius had in the 11th year of his reign appointed a certain feast, called *Rubigalia*, in honour of his God; and which in Pliny's days^b was observ'd on the seventh of the Calends of May, that is on the 26. of April, as at that time plants are most obnoxious to mildew: And all this to the end, that this heathen Deity might avert from the fields so noxious a thing as mildew, as they were firmly persuaded, that this disaster came from heaven. 'Mildew,' says Pliny^c, is a disease of corn and the vine, sent from heaven'. This the Greeks hence called *Αστροφολισμός*, and the Latins, *Sideratio*; but in its effects they consider'd it as the greatest plague of corn. Pliny in the above place ascribes its cause especially to the noxious influence of the dog-star: Hence they us'd to offer up a dog both to *Rubigus* and the dog-star, as Ovid at the end of the 4th Book of *Fasti* shows.

*Flamen in antiquæ lucum Rubiginis ibat;
Extæ canis flammis, extæ daturus ovis;*

namely, the *Flamen Quirinalis* must perform this religious ceremony without the city, and pour wine and incense on the entrails of the dog^d. In-

^a Vid. Varro lib. 7. cap. 1. p. m. 359. Ed. Zwingeri de methodo rustic.
^b Hist. Nat. l. 18. c. 29. p. m. 338. ^c Id. cap. 17. p. 327. ^d Alex. ab Alex. Noct. geneal. lib. 3. cap. 12. p. m. 142. b.

stead of which Christians afterwards, and in different places, even at this day, make their processions round the corn fields.

And how what?

And indeed this is a disaster very prejudicial to trees and corn, but whose true nature is not hitherto known, as the importance of so common a phenomenon requires, so far that one can learn but little even from experience and knowing husbandmen and gardeners, besides what they have learn'd, not so much from their own experience, as rather from common tradition: And hence it is a difficult matter to give a circumstantiate and true history thereof, on which we ourselves have employ'd much pains yet could not in all things attain to the wish'd for satisfaction, especially as we could not in person with sufficient distinctness observe the true nature of this phenomenon abroad in the fields, unless we happen'd to be there by chance, as we were confin'd to a city life. What we could learn from the information of others, and also in part from our own observation, is principally as follows: Mildew chiefly happens in the spring, especially about the time of the shooting and blooming of the corn, and at the time of the budding and blossoming of the trees, both which it usually affects, nay all beans and other pulse, yet not promiscuously, but often one garden before another, nay sometimes one tree or species before another, and often on one side thereof. It is observ'd to be more or less plentiful one year than another, and especially when warmth, heat and sun-shine ensue a preceeding wet: In this manner *Ramazzini*^e remarks, that it appear'd in particular in great plenty about *Modena* in *Italy*, about the summer-solstice of 1689 on trees, wheat, beans and other pulse, after much spring-rain; as also in 1690, at the beginning of *June*, after preceeding rainy weather, and not only on low but also on high grounds: The like was also observ'd there in the following years^f. The same was also observ'd by *Marc. Gerbecius* at *Labach* in *Carniola* in 1698^g; as also by *Hoyer* in 1699 almost all over *Thuringen*^h, and by many others. Generally it is observ'd in deep, moist or woody grounds, in which manner also *Pliny* says, 'it is very common in wet tracts and valleys, not expos'd to the wind: On the contrary, wind and high places are without it.'ⁱ It is constantly found after wet and warm sun-shine ensuing thereon; and it is generally assur'd, that it is originally produc'd in a small rain during sun-shine, especially in the morning. It settles upon the bloom and young shoots of trees, as also on the ears of corn, &c. like a clingy, yellowish, or even greenish matter often in great plenty, and pastes together the heart-blades and bloom in such sort, that they quite lose the power of shooting; Whence they fade, shrivel and fall off, at the least it remains on the blades, that continue brown

^e Dissert. de constitut. anni 1690. in *Misc. Nat. Cur.* Dec. II. An. 9. app.

^f *Id.* ejusd. constit. An. 1690, 1692, 1693, 1694. in *Misc. Nat. Cur.* Dec. III. An. app. p. 63, seq; ^g *Chronol. Med.* An. sec. p. m. 183. ^h *Misc. Nat. Cur.* Dec. II. An. 9. & 10. Obs. 93. p. 171, seq. ⁱ *Plin. lib.* 18. cap. 17. p. 327.

yellow spots: The taste of mildew is sweet, yet somewhat piquant; and bees readily use it: Yet one species thereof is better for them than another. In this form it lies for many days on the trees and corn, especially if the sun does not timously dry it up, or the rain wash it off: Yet we have not been distinctly inform'd, that also in this form it is found on grass. In particular, we are to remark here, that in the honey-dew on trees almost always small maggots and caterpillars are found, which by their gnawing of the minute *stamina* and pedicles of the blades and bloom promote their falling off: Yet in the honey-dew of corn the like is not observable; and among all trees the hazel alone remains free of honey-dew, as *Ramazzini*^k and *Brunnerus*^l remark.

The effect of honey-dew consists principally herein, namely that trees much affected therewith lost this year all their bloom and fruit. Corn remains barren or degenerates into what is call'd mildew'd corn^m; nay it proves prejudicial to cattle, especially sheep, as also to men. As to our own observation in particular, which we had occasion to make this month about this *phenomenon* in person, it consisted herein: Soon after *Easter* we observ'd in a woody ground near the *Oder* much honey-dew on fruit-trees, which had already fallen on *Good Friday*, namely the 15th of *April*; we remark'd that, for the most part, nay almost solely it affected the young apple-trees, namely on their flower-buds settled a tough, yellow matter like thin honey, somewhat sweetish; the bloom, on which much of it settled, appear'd on the out-most blades as if singed, and when touch'd, the whole bloom and bud fell off; and the ground beneath was as much singed and appear'd as yellow as the blades: The leaves of the tree, which stood on the flower-buds, were partly fatty and clammy, and partly here and there beset with yellow, brownish spots, and partly appear'd somewhat shrivell'd; yet these fell not off like the flower-buds, but remain'd fast. Upon enquiring, whether this honey-dew was suddenly and all at once observ'd, we were told, that at first only something of it was observ'd; yet that it was most of all first perceiv'd in the like preceeding heat; and that it was probable, that the heat had either forced it out or collected it. Upon enquiring, why other trees were not in like manner affected with it, we were told that the then rain did not fall in one place, or that these must be the most sensible flowers: To this was added, that no bee would meddle with the yellow, but readily with the white sort; that the yellow was very noxious.

As to the nature and generation of this honey-dew, the opinions of husbandmen and naturalists are various: Some of which derive it from an evil constellation, as in particular the ancients, according to whose opinion, it is in *Pliny* call'd *saliva siderum*; but others, and those the greatest

Opinions about
mildew varies

^k L. c. ^l *Mif. Nat. Cur. Dec. III. An. 2. p. 351.*
Dec. III. An. 2. Obs. 224. — It. An. 9. & 10. Obs. 93.

^m *Vide Mif. Nat. Cur.*

greatest number even at this day, from the earth and air; yet some also from the plants themselves. The most common notion is, that honey-dew falls down from the air; and it is a common way of speaking among husbandmen and gardeners, that a poison, a noxious honey-dew or mildew is fallen; and in this manner all trees and plants indifferently and equally, nay men and beasts in the same district, must be affected with it, which yet runs counter both to experience and history: Most people hold it for a sort of corrupted dew, and that partly of a lixivate, alkaline nature, partly and mostly of a sharp, sour and corrosive nature as *Ramazzini* affirmsⁿ. As common dew is of a saline, volatile nature, from which may be prepar'd a spirit that resolves metals, as for instance, *Cnoeffelius*' *menstruum* for preparing the tincture of corals; to which if nitrous and acid corpuscles are associated, and which ferment together in the air and then fall down, honey-dew is produced; to which *Gerbezius*^o and *Fromman*^p add, that with these corrosive vapours, drawn up out of the earth and sea, there are sometimes arsenical *balitus*' complicated. *Jz. Borrellus*^q holds it for real *aqua fortis*, and is of opinion, that mildew may be produced by art, especially by means of lime and brick-kilns, glass and smelting-houses, where they deal much in antimony and other minerals, whose fumes may by the wind be driven on trees and fields. Now such vapours may be drawn up by the heat of the sun out of the earth that is hitherto shut up, and at last fall down out of the air in form of a dew, or in rain; yet as this opinion has many and those no small difficulties, so in particular *Joh. Sam. Tromsdorff* has oppos'd this opinion in a disputation at *Erford* in 1699 under the title of *Ros mellis non Ros nec mellis Ros*, &c. wherein he maintains that honey-dew is properly no dew, but an extract and exhalation of the plant, particularly of corn, not yet fully ripe: Hence it is not universally found in all plants, but such as have an over-abundance of sap; and he gives the following definition of it; 'it is an aqueous, hypostatic meteor, drawn by the heat of the sun from the seed and leaves of plants, especially the long stalk'd ones, and from their superfluous moisture, which in some is conjoin'd with sulphur, condens'd by a weak degree of cold, very noxious to the corn, first of a ruddy colour, but afterwards degenerating externally into blackness, design'd for the punishment of men, and the glory of God.' And certain it is, that this opinion in general, to wit, that honeydew has its true original from the plants themselves, seems to come nighest the truth, as from this the *phenomena* thereof may be illustrated to the best advantage; for, it is well known, that corn, for instance, at bloom-time sensibly exhales, so that we may partly smell the vapour and partly see it with our eyes in form of a thick fog. The sensible and remarkable smell of fruit and forest-trees, as of oaks, pines, firs

ⁿ Diss. de constit. An. 1690. Misc. Nat. Cur. Dec. II. An. 9. app. p. 37.

^o Chronol. Med. An. 2. p. m. 183. p Misc. Nat. Cur. Dec. I. An. 6. & 7 Obs. 186. p. 25c.

^q Obs. Med. Cent. 3. Obs. 87. p. 165.

firs, wild-pines, willows, &c. at their first budding and blooming shows how great a quantity of exhalation they yield: But scarcely from other trees, especially as it may be suppos'd to be of a more sulphureo-volatile, fat and active nature; and one tree yields these vapours more plentifully than another, yet not always in equal quantity at one and the same time, but at different times, as the heat of the sun, and the warmth of the air by day and by night are of any considerable degree, and of any continuance: And do these circumstances follow upon the back of much preceeding wet, these vapours at one time or other being plentifully discharged from plants, are thus compleatly dissipated in the air; but does there hereby arise a moist and cool air, that these exhalations cannot sufficiently expand, and the ordinary dew be still added thereto, or also those sun-rains, as they are call'd, with which these vapours combine, they soon again settle upon the plants, and in this mixture form such a clammy substance; but which then in its nature does not necessarily, by virtue of any corrosiveness, but simply, on account of its glutinous and clingy nature, check the mounting juice in its circulation, and the growth of the plants in their tender expansion; that hence the natural force of the plant in those parts ceasing to promote the farther mounting of the juice, it gives occasion to the nourishment being diverted some other way, and destroys all the buds; and these our thoughts do for the most part, as to the effect of mildew, coincide with the opinion of Dr. Hoffman at Hall, who in a M.S. physical college or lecture says; 'it is a vulgar opinion, that mildew is poisonous and very corrosive, because it is noxious to the fruits and a hindrance to their fecundity; whereas it usually does harm by its sweet viscosity alone, namely as it obstructs and shuts up the pores, as of wheat and rye in bloom, or when the seeds begin to be elaborated; and hence the pores being block'd up, their further nutrition and augmentation is entirely impeded. But mildew acquires a corrosiveness, namely as by the heat of the sun, the acid, saline *spicula*, of which all sweet things consist, are call'd forth and exalted; which, besides the preceeding obstruction, also corrode and eat out the tender fibres of vegetables, &c.' And this final corrosiveness of a sweet liquor, which in time becomes acrid or acid, is very probable, only that it is not thought to be in this form drawn out of the earth or plants. And this is our opinion as to the generation of mildew.

There remains behind to alledge another opinion, which is that of *Lewenhoeck's*^r, who not only denies, that honey-dew falls down from the air, and has an affinity with dew; but by means of his microscopical observations he avers, that it is nothing else but an infinite number of the smallest maggots and their *ova*: And in this manner also *Chr. Frid. Garman*^c holds

^r Continuat. arcan. Nat. detect. epist. 104.

^c Oolog. curios. Dis. 2. § 206. p. 220.

holds, that mildew is nothing other than a vast number of small winged insects. Of mildew this is too clear to require any laborious proof; yet of honey-dew it does not hold with equal clearness, especially as M. *Lewenboeck*'s head was full of nothing but *animalcula*; and in this respect he has been oppos'd by *Job. Georg. Hoyer* at *Mublhausen*^t, tho' this latter cannot deny, but that sometimes all manner of maggots with their flaver and dirt usually pollute and eat up the plants, and consequently produce an effect like honey-dew: And he allows, that he once observ'd how from each drop of the honey-dew a single maggot, and out of that, in a little time after, a green caterpillar was produced: In which manner also *Job. Conr. Brunnerus*^v alledges, that he found small maggots on the leaves spoil'd by the honey-dew. Yet this notwithstanding, the above-mentioned *Hoyer* denies, that honey-dew in its entire substance is any thing other than a congeries of small maggots and eggs, as the eye often sees thro' microscopes something different from what is actually found, especially as by virtue of the alledged observation, no more than a single worm was to be found in one drop of honey-dew: And if *Lewenboeck*'s opinion were sufficiently grounded, we must believe, that certain insects lay their *sperma* together with their flaver and other filth on plants, which then together appears like honey-dew: Whereas it rather seems probable, that this maggot-feed is laid in this clingy matter, as in a *matrix*, in which at length the above brood is produced. But to the demonstration of the vermicular nature of honey-dew, more circumspection and a greater number of observations are requisite. Yet we must here alledge what we were told about the cause of honey-dew by an experienc'd husbandman; he assures us from his own repeated experience, that honey-dew is produced on trees in the following manner: In harvest, namely in *August* and *September*; a very small worm eats into the flower-buds and lays an egg therein, which in spring creeps out a maggot and gnaws the heart of the flower-bud, out of which the sap runs out, especially in strong sun-shine, and, indeed, in such plenty that the boughs are wet with it. He thinks this may be prov'd, if in winter one bring a sprig, wherein such egg is found, into a warm stove, the maggot becomes alive, and by its gnawing causes the sap to run out: At last from this maggot is produced a larger one, which in a microscope appears like a chafer, a little bigger than a large flea, of colour greyish, reddish, green, and yellow. How far this holds we cannot say; and whether the sap that runs out be the same with what is call'd honey-dew; at the least were it so, the honey-dew on trees must be quite different from that on corn; and perhaps there is a real difference in this case, according to the different sorts of trees, which in general is the reason, that mention is made of different sorts of honey-dews, as if at one time there fell a white,

at
^t Misc. Nat. Cur. Dec. III. An. 9. & 10. Obs. 93. p. 173. It. Cent. I. & II. Obs. 117. p. 241.
^v Misc. Nat. Cur. Dec. III. An. 2. Obs. 224. p. 351.

at another a green or yellow fort : Whereas notwithstanding, it is barely different, according to the exhalations of the different species of plants.

An Observation on medicated Whey. By Georg. Frid. Gutermann.
From the *Commercium Literarium Norimbergense*. An. 1732.
Hebdomas IV. p. 30.

Translated from the LATIN.

IT is, indeed, a very useful method of the illustrious Dr. *Hoffman* to prescribe drinking *acidulæ*, mixt with milk ; and of such patients, as us'd my advice, there were some who drank the *Selteran* waters, mixt with milk, and that either cows or goats, as our country or neighbourhood affords no asses ; that I might, therefore, prescribe such a quantity of the water as should produce the desired effect, and such a due proportion of milk, that useful liquor both for supporting and refreshing the human body, both in a sound and unsound state, as not to overcharge the drinkers with too much water and milk, and to free the milk from its cheesy and useless *magma*, I propos'd, after the example of *Hoffman*, first to evaporate the milk in an earthen vessel by a gentle fire, and till it is cool'd to pour to it the destin'd quantity of water ; and by this means by stirring it I separated that genuine sugar of milk : Thus one pound of this milky water or of the *acidulæ*, impregnated with whey, consisted not only of an entire pound of water, but of an equal, or if you will, a greater proportion of good milk : And I cannot help mentioning the good effect, which above other things it had on a certain studious young man, who had been very often troubled with hypocondriac and arthritic disorders, and was brought very low, but is now in perfect health. At other times I was wont to procure sweet genuine whey without evaporation or without any thing the least acidulous, and that by an experiment borrowed from the kitchen. I took, for instance, 2 lb. of milk, which I put in a copper over a gentle fire, and when just ready to boil I order'd to put 6 or 8 eggs into it: Thus by the gentle heat the eggs unite with the cheesy part of the milk ; and all the pure whey separates spontaneously, and is very sweet. This very simple method, and, indeed, the best for obtaining whey, was formerly communicated to me by *Alex. Camerarius*, professor at *Tubingen*.

I shall here subjoin the manner of preparing the *lait coupé* of the French, as it is only known traditionally, differing a little from that which *Boecler*, professor at *Strasburg*, gives in his *Cynosura materiæ medicæ continuata*, p. 794. Take of oats and barley, wash'd in spring-water, of each a handful ; boil them over a gentle fire with 2 lb. of spring-water, till half be boil'd away : Thus also boil 2 lb. of milk, and while the milk gently boils, the skin appearing on its surface is to be taken off, till 1 lb. of milk remain,

U u 2

which

Medicated whey
how made.

Manner of pre-
paring the *lait*
coupe.

which is afterwards mixt with the decoction of the oats and barley; strain'd thro' a linen cloth, and sweeten'd with sugar to your mind, it is fit for use.

Of the maturation of Amber, and the bringing of it to perfection, both by art and nature. From the Electrologia of Nathan. Sendelius. Ann. 1725.

Translated from the LATIN.

Several sorts of
amber nam'd
from their colour.

SUCH as have given us a description of ambers exprefs, and with application have enquir'd into their nature, no sooner began to know and handle them, than according to their different colours, which vary much among themselves, they also nam'd various and distinct kinds thereof, and to this day offer'd them to us; so that if you would calculate their number, and advert to the whole train of white, milky, pearly, wavy, golden, yellow, dark, pale, dun, variegated, blue, green, black and the other ambers, and also consider their greater or less difference, you might reckon upwards of 600 of them.

Reduced to two
classes by Hart-
mann.

In this great store and apparatus of ambers, tho' there be a pretty wide difference, yet there is no necessity for going in to the opinion of those, who thence would make different species of them, as this has been sufficiently confuted by *Hartmann* himself^a, calling that difference a difference of degree and not of species; and reducing their large and confus'd number to two classes, viz. the whitish and yellowish, and to these alone he contends, that the mixture of the other colours may and ought to be referr'd.

The author's di-
vision.

But as with *Hartmann* I pronounce that ambers differ in degree, I shall undoubtedly be call'd upon, in the first place, to make out some higher degree, from whose perfection the qualities and affections either essential or accidental, of the other ambers, which are less in degree and less perfect, may appear: And this knowledge of perfect and imperfect ambers is, therefore, not only useful and necessary, that those different degrees, in respect of the matter of amber and its other affections, may be known; but that also at the same time it may appear, whether nature continues to ripen ambers more and more; and moreover what helps she uses therein, that after changing their jejune and vicious nature, she may produce perfect from imperfect ambers.

All which if we compare with *Hartmann's* restriction and division of ambers, viz. whitish and yellowish, it will easily appear of what little avail it is here; for, these mention'd classes do in general distinguish ambers only according to their colours, tho' it is evident, that neither all sorts of colours, especially the more rare, can be included and comprehended in these: But that neither the whitish nor yellowish can be reckon'd the capital

^a Hist. Succin. Praef. lib. II. cap. 4. § 7. — 11.

pital degrees or the more perfect ambers, appears even from the author himself, as he affirms, ‘ that these may be changed in a still higher degree ‘ into sparkling and pellucid, but those into white ^b:’ But he still leaves us in the dark with respect to the highest degree of perfection.

Hartmann^c affirms, that he has been shewn by workmen, that all the inferior colours may by the force of fire be exalted to a higher degree, and this effect, which he allows to art, he denies to nature. In the other kingdoms, as the vegetable and animal, we observe, that nature intends perfection, nor is this to be denied in the mineral kingdom; for, minerals are prepar’d and ripen’d in their veins, till they arrive to that perfection nature design’d them; and ambers, like other bodies of the earth, cherish’d by heat, and at length furnish’d with larger supplies of juices, are ripen’d and attain to their perfection.

But in what the perfection of ambers consists is a hard matter to determine. *Hartmann*^d reckons the white and milky ambers the most valuable; and he expresses his surprize, that the *Romans* formerly, as *Pliny* remarks, put no value on the white, as they are the most rare to be found. Next to these he classes the wavy, the sparkling and the yellow; and again in another place he makes the perfection of amber to consist in its hardness^e; and again in another place he commends its purity and brightness^f; but most commonly and in general he fixes the difference of ambers in their matter, colour, odour and effects, distinguish’d according to more or less^g: I also consulted the artists that deal in amber, and they were all of *Hartmann*’s opinion, and that the rather as of the pearly kind several toys are made; so that thus I could find no satisfaction from either of them.

Wherein the perfection of amber consists according to *Hartmann*.

That I might at length find out and determine what those ambers are, that are so elaborated in the highest degree by nature, as to be capable of attaining to no higher, and in respect of which perfection all the others may be called imperfect, I have examin’d and collected various sorts of amber of different sizes; for this end, therefore, examining those neglected small pieces, with which the shore is sometimes strew’d all over, I found them all clear, transparent and sparkling, excepting only a very few obscure glebes, but which were chiefly furnish’d with acute angles, and which, therefore, seem’d to be torn off from the larger glebes.

According to the author.

The greatest part of those joints, as they are call’d, which are turn’d in the lathe, were clear and transparent, but the middle somewhat obscure, and inclining to clearness. In the larger common balls for the lathe, on the contrary, the darker parts were uppermost, with the clearer beneath, so that by estimation the latter made a sixth or seventh part, the other parts remaining either entirely, or in some measure at least, obscure; and of those, whose dark part was outmost, there were not a few, which seem’d inclin-

ing.

^b Ibid. § 11.

^c Ibid. § 12.

^d Ibid. l. 1. c. 7. § 6.

^e Ibid. l. 2. c. 2. § 8.

^f Ibid. c. 4. § 7.

^g Ibid. § 7, 8, 9.

ing to clearness; as some of them were clear, not only for half their bulk, but likewise others, on their edges and externally, shew'd a degree of clearness the breadth of a goose-quill, so as by the saw to be separated from the remaining darker part. In the largest glebes of all, which weigh from half to one nay two, but rarely three pounds, this clearness was so rare, that the larger these glebes were, they shew'd the more obscure. And on the contrary, the greater transparency was observ'd, the smaller they were; and this brought a hint into my mind, whether all the obscurer colours of amber are not chang'd by time, and made to put on a sparkling brightness; and nature seems to have less trouble in perfecting and clarifying those smaller glebes than the larger ones: And upon accurately examining not only such as were half clear, but such as were more superficially so, in the confines of those different colours I observ'd a darker cloud so dispersed, that the bright and dark parts run into one another; and which I observ'd more evidently in other glebes, where the obscurity being entirely discuss'd, there only remain'd in the middle a kind of thin cloud scarcely hindering the transmission of the light: And hence it seem'd agreeable to reason, that the portion, which became clear, was before very like the darker part, and that this darker part would arrive to the same transparency, had the glebe been suffer'd to lie longer in the earth or in its own veins; whence it appears, that nature attempts this change first from the external parts, and in this, art imitates nature, as we shall observe hereafter. And I myself have had an instance, by which it appear'd, that amber even by keeping undergoes this change; and this also has been observ'd by others. Tho' it is not to be denied, but that sometimes one side, especially in the larger and broader glebes, is observ'd clear and transparent, while in the mean time the other remains still obscure, tho' this also, in time, wears off; which change is brought about by its transpiring, by the rolling of the sea, or by the cherishing heat of the sun.

According to the
author.

Its perfection
consists in its
transparency.

From these observations, therefore, I concluded, that nature attempts the perfection and maturation of ambers, and that this their perfection is their clearness and transparency, whereby they transmit light in the manner of glals; whether this transparency be of the diamond or wavy kind, which is the better and more perfect sort, and happening in the purest, pearly ambers, or whether only it be a ruddy or golden transparency: And the more ambers recede from this transparency, the more they are class'd among the imperfect, commonly call'd bastard, ambers; not that these are not genuine, but that they were not allow'd to arrive to their degree of perfection. The other properties of amber, as its hardness, odour and colour, are not to be compar'd with this property of transparency, as they do not strictly involve any degree of perfection, and especially as some of them may by art be corrected, as shall be shewn below.

Hart-

Hartmann calls the hardness of amber its greatest glory, and that it is the more perfect, the more solid it is^h: Yet all hard ambers will not be perfect, as it may happen that they are not transparent, as is always the case in pearly ambers, nay and sometimes in most others. Yet those that are transparent are always hard, unless they should happen to be spoil'd by some accident; for, all ambers expos'd to the sun's heat, tho' they have a thinner and more friable coat, yet within they have a very hard and transparent body: And hence it is, that clarified by art, when before they were not hard, they afterwards become so, as we shall shew below more at large. And I know of none harder than the wavy sort, which often blunt the edge of a knife, so as to require repeated whetting; and which is more, the clear part of the amber glebe is always the hardest.

According to
Hartmann in its
hardness.

Having thus establish'd the preheminance of the transparent ambers as the most noble, the degrees of the others, as the more ignoble, may be distinguish'd from their more or less coarse texture; namely as their matter and sulphur are found more or less digested, as according to these, light finds now an easier, again a more difficult passage: The principal, therefore, will be the clear and transparent ambers, whether they be the wavy, which transmit the light very freely through their pores; and consequently are the most to be regarded and the most valuable; or whether they be of a golden or ruddy transparency, in which indeed the light is with equal freedom transmitted, but along with some reflexion and refraction of the rays, that the light may the more strongly show the golden colour. From the transparent, all the other cloudy and opaque ambers should be distinguish'd, among which the scaly challenge the first place, distinguish'd with very thin, obscure interstices, some of which are observ'd to be of the pearly kind, and more whitish; but others of the common obscure kind, and yellow; In both these kinds the light is still in some measure, but not perfectly and freely transmitted: However, ambers of this texture and consistence stand in the first place for attaining to perfection: And I have often observed, that by their own proper motion and by bare transpiration in a little time only their thin clouds diminish and are at last dissipated. Next to the scaly succeed the dense pearly, and the others, more obscure, as the waxy or pale yellow; in such manner that as among the scaly the pale pearly are the best, so among these last the dense or thick pearly are the principal; and that on account of the more rare and pure texture of their sulphur, mixt with a very tender volatile salt, whereby they become fitter for attaining to their future clarification and perfection. Both these ambers do still with greater difficulty admit the light, and that the more as the yellowness seems to run off into obscurity. But both the pearly and pale yellow require no great time or labour to their clarification; nay, the former require less labour of art and nature than the latter,

The more igno-
ble ambers
whereby distin-
guish'd from each
other.

^h Hist. Succin. *Pruss.* l. 2. c. 2. § 8.

latter, especially if no great degree of whiteness be mix'd with them ; for, the more rare the whiteness appears, the more dispos'd these glebes are to transparency, and *vice versa*. What judgment we are to form of the obscure yellow, and other opaque ambers, as those of a liver-colour, carnation, black and other mixt colours, is evident ; the texture of which ambers, on account of the grosser matter of which they consist, as also on account of the admixture of many heterogeneous parts, transmits no light at all, nay entirely stifles it : Whence either with difficulty, or not at all, are these clarified. There remains the white, a peculiar kind of amber, which has united with its sulphureous parts, white, saline, heterogeneous matters ; and such ambers both terminate the sight, and on account of their polish'd surface again reflect the light as it fell.

The maturation,
 &c. of ambers,
 where perform'd.

The maturation and clarification of ambers is perform'd both in and out of their veins, but more frequently in their veins : And the reason, why both the perfect and imperfect ambers bear the same price is, that the imperfect and opaque may be easily and at a low expence made transparent : But what I have said here is to be understood of the common and ordinary glebes, in regard that the larger transparent glebes, both for their uncommonness and price far exceed all the obscure, nay, the pearly ambers themselves. And the reason why these larger transparent glebes are more uncommon is, that they require a longer time for their maturation.

The operations of
 art on amber.

We shall now proceed to the several operations of art perform'd on amber, as the coction, digestion and maturation thereof, and whereby those of nature may be illustrated. The art of polishing amber seems to have been known to the ancient *Romans* ; and doubtless, being lost in a length of years was afterwards recover'd in our days. *Archelaus*, king of *Cappadocia*, says *Pliny*,^a relates, that amber is polish'd by boiling it in the lard of a sucking pig ; and by that politure *Pliny*^b certainly means, that a clearness and transparency are conciliated to amber : And the same *Pliny*, tho' for another purpose, to wit, the tinging of amber, makes mention of the coction of amber in the fat of kids, so that the *Romans* must have known the true oily *menstruum* for boiling amber ; but that afterwards the art seems to have been lost, as I find no traces of it for many ages ; and the discovery of it by the Moderns scarcely exceeds half a century : Besides, the moderns at first attempted that transmutation by digestion in sand, induced, probably, from this reason, that they observ'd, that ambers become always transparent and clear, bak'd by the sun's heat in the sand. This art was first discover'd at *Dantzick*, from whence it spread into other parts : And as it is always easy to improve upon inventions, they devis'd another method, which was to boil and digest amber in rape-seed oil, which method, the former being laid aside, still continues to this day.

^a Lib. 37. c. 3.

^b Id. *ibid*.

As to that first digestion in sand, it was managed in the following manner: The workmen committed the amber, that was to be transmuted, to an iron pot, into which sand was put, yet so that the amber should not approach the pot too nearly and suffer by too much heat; and this they provided against in the following manner: After first wrapping up the amber-balls in paper, they so dispos'd of the sand on the bottom and sides of the pot, that they should every where possess the middle place, and be out of the reach of the fire; and putting coals at some distance to the pot, they at first made a gentle fire, which they afterwards heighten'd gradually, till they found the clarification accomplish'd, which took up, as they say, the space of 40 hours: And that they might not be deceiv'd or disappointed in the event, they added to the other ambers certain proof-balls fasten'd to a thread, which they could take out and put into the sand, so that as these were more or less pellucid, they might form a certain judgment about the rest. Thus assur'd of the work being compleated, they again remitted the fire, and did not take out the ambers till the whole was cold, lest, which easily happens, it should crack by being expos'd to a sudden and uncommon cold.

The ancient method of clarifying amber.

Such was the ancient coction of amber, and not so long ago laid aside, and which I may call the dry coction, and in our days succeeded by the humid, as all Artists in clarifying amber do now boil it in rape-seed oil: The process is, as follows: They build a quadrangular furnace, internally 2 foot and upwards over, and 1 foot high, according to the greater or lesser capacity and bigness of the pot they design to use; then the pot is cover'd with a dish, fill'd with oil and amber, and set in the middle of the furnace; a coal-fire at its four corners, carefully remov'd from the pot, is heighten'd by due degrees, 'till the amber is observ'd to boil, which they examine by removing the dish: This boiling is continued more or less for twenty hours, as the size of the ambers is greater or smaller; and the proof-balls, which they here likewise fasten to a thread, and pull out at pleasure, show, whether the clarification be finish'd or no; then the fire is remitted; and all being suffer'd to cool, the ambers are taken out, and to be separated by the workman's hand, that the perfectly clear may be wrought on the lathe, but the cloudy and the imperfectly transparent be committed a second or a third time to the fire.

The modern method.

These are the two methods of clarifying ambers; and here it may not be improper to enquire, which of these is the better, or at least in what respect the one excells the other; the former, indeed, is the more natural, having nature itself for its guide, and therefore not without its praise, in regard that it both reduces the ambers almost to a glassy transparency, which in the latter humid way seem to retain a cast of yellow; and also that it makes them compleatly hard, a thing I myself have often observ'd with pleasure, when in distilling any medicine from a sand heat, I sometimes committed

Which the preferable method.

to it amber-cakes, and sometimes smaller balls: Whence this is my favourite method, as in it you may in the mean time do any thing else; however the workmen complain of the longer time it takes up, in which there seems not to be much, and which notwithstanding might doubtless be remedied, if, as in their boiling in oil, they repeated the work that was less perfect. But I imagine that the moderns principally have abstain'd from the ancient method of clarifying, because by a somewhat intenser heat the amber-balls are oftner crack'd, which cracks made in sand are observ'd red and unseemly; but if they happen in boiling in oil, they are not so much seen on account of the greater paleness: Not to mention, that the external face of the amber is much burnt, and consequently, that much of its weight is lost by taking away and correcting that burnt crust: Besides, that extraordinary hardness, which ambers acquire by digesting in sand, was not so agreeable to them, as it blunts the edge of their tools: Whereas, now, on the contrary, by boiling in oil they become much more tractable: And the better to promote this tractableness (because ambers boil'd in oil acquire a greater degree of hardness) some workmen mix a tallow-candle or some tallow with the oil, and by this they observe, that a too great degree of hardness is prevented.

Whether ambers
are soluble.

It is pretty much disputed, whether ambers are soluble. And to speak the truth I join with those, who chuse to call the solution of ambers with spirituous *menstruum's*, especially spirit of wine, a tincture rather than a central solution: In like manner also the thing is manifest as to oils; for, if with them you attempt a solution of amber, you can hence obtain nothing other than a slight emollition, a thing *Hartmann*^c testifies of oil of pine, which is of great affinity with amber: Whence those may look to it, who with *Bartholin*^d scruple not to commend so very much the oil of lavender in this solution. What credit is also to be given to *Aufelmus de Boot*,^e when he boasts, that he is master of the art of dissolving and coagulating amber again, I leave to the judgment of others; but I am certain this is an art we know nothing about. But to speak what I myself have observ'd; tho' I take the solution of amber to be a very difficult thing, yet I am persuaded, that it cannot be entirely deny'd, as I have often seen with my own eyes, that by only boiling some amber-balls in the common rape-seed oil, they were so dissolv'd, as at least to leave behind some thin cases, almost like honey-combs, the whole body of the amber being almost dissolv'd and deriv'd into the oil; and of these cases I keep some by me: Yet I should think, that such dissolv'd amber was not of the harder or indurated, but of the friable kind.

But this by the bye: And to return, there are not wanting many other *recbeirefes*, by means of which you may perform with less labour, what

^c Hist. Succin. Pruss. lib. II. cap. 2. § 5.
An. 1742.

^e Lib. II. cap. 162.

^d Vide Acta Germanica Vol. I. p. 266. 4.

you have seen done more operosely by the methods just mention'd. One compendious method is, as follows; put the amber you design to clarify into the tube of the heated furnace, covering it all over with sand, so that it may not touch the furnace and sustain too strong a heat; for, thus as the heat rises gradually to the highest degree, so it gradually remits; and in this easy experiment you shall not entirely be disappointed. But the plates to be committed to the heat or fire must be somewhat more tender, and the balls not very large; for, otherwise they will scarcely answer in a shorter stay in the fire, without repeating the work over and over. I have, indeed, very often us'd this method in the winter time, but you are to observe, that all the success depends upon the degree of heat; for, as it is moderate, or otherwise and too strong, your amber will sometimes be either very beautiful; or at other times on the contrary, marr'd with unseemly cracks and fit for no one purpose.

A compendious method of clarifying Amber.

There is another method of ripening and perfecting amber (not irksome, on this account indeed, as it requires but a very little time) and that is, to expose the amber-plates to the flame of a burning candle; and these plates must be such, as are not totally obscure, but have only thin clouds as the amber of the scaly kind; such amber, cutting it into thinner plates (for, neither the time nor the degree of heat are proportion'd to the thicker ones) the workmen take up with a pair of tongs and often shift it over the flame; and in thus shifting it they also rub some suet or oil on the plate, the better to promote its clarification, and prevent its cracking in a naked fire: And thus as the heat gradually pervades the body of the amber, the clouds are in an agreeable manner seen to be dispell'd; then they wrap up the amber-plate in some linen cloth or filtering paper, that it may gradually cool; which is a caution to be observ'd in this case: But what is no less remarkable, when the amber is cool'd otherwise, which is surprising, the cloud returns almost with the same degree of obscurity.

Another method

This *encheliresis* has always been my favourite method, whence I have often us'd it: But as it is accompanied with a stench, caus'd by the suet or tallow, rubb'd on the amber, it is at the same time disagreeable, unless performing the operation under a chimney may be thought a remedy: Whence as I was meditating on another method, instead of tallow I rubb'd on the plate distill'd or other oil of amber, with a view of greater success; but, as it seem'd to me, the stench was but little corrected, and the operation, in point of dispatch, by this method not remedied, only that the amber seem'd to become harder: Not to mention, that there is occasion for often sprinkling with this and the other distill'd oils, on account of the volatile parts, which visibly fly off like a vapour: Whence in fine, whatever quantity of any oil is sprinkled on ambers (and chiefly oil of almonds, nay plain wax producing the same effect, recommended themselves to me) it only contributes to check the too great motion of the fire on the ambers,

Some disadvantages in it.

and to prevent their cracking, as I not only now but formerly conjectur'd.

The clarifying of
amber, owing to
the fire by means
of oil, &c.

From all the methods of clarifying amber you must conclude, that the whole of the effect is owing to heat alone, which promotes more strongly their transpiration, otherwise too slow of itself; and if applied on any occasion with caution and in a due degree, you shall promote the transpiration in many other ways, as was describ'd above. A workman lately happen'd to let drop out of his hands into a boiling kettle of fish a glebe of amber, which remaining in the liquor till the fish was done, and being before somewhat more obscure, now came out sparkling and shining. That I might imitate this chance experiment, I took a thin and scaly plate of amber and threw it (which yet I ought not to have done) into hot boiling; saltish and partly fat water, wherein fish were boiling: After the boiling was over, I observ'd the plate, thro' my own fault, indeed, crack'd on its exterior cortical part, doubtless, owing to the sudden heat; but after removing that coat and polishing the plate, it became shining and transparent. For brevity's sake I omit the experiments I made for clarifying amber in boiling coleworts or beef. It is sufficient at present to observe of all of them, that in whatever oily *menstruum*, or which partakes of oil and fat, ambers are boil'd, provided there be a due proportion between the agent and patient, and a due regard be had to the degree of heat, to the manner of boiling, and to the time, they may be heighten'd to clearness and transparency.

A passage in
Pliny corrected.

From all which, as you see, that amber may be clarified by so many oils and different fats, you will, no doubt more readily come into my opinion, hinted at above, namely, that they may be transmuted in the manner that was known and us'd among the ancient *Romans*, to wit, by boiling in the lard of a sucking pig. But it may be matter of dispute, whether there be not a mistake in the passage of *Pliny*, in which *adepts suis lactentis*, the lard of a sucking pig, may be put for *suis lactantis*, a suckling sow, as such a quantity of pig's lard could not be easily procur'd, as would be necessary in this operation. And this I am the more inclin'd to think from the word *lactantis* being set down in the margin of my copy of *Pliny*, as the ancient reading; and which is instead of all proofs, the experiment of boiling and clarifying ambers in the lard of a suckling sow does answer.

The difference
between several
oils, with their
effects on amber.

But it is a thing of greater importance to enquire, what may be the difference between the several oils and fats, or what qualities, as in point of hardness, and softness, or other affections, amber may acquire in the different boilings; for, as it is certain, that boil'd ambers retain not the same degree of hardness, but according to the oils and fats made use of, it is sometimes increas'd and sometimes falls short, we might hence probably judge, that on account of the greater efficacy which fats have to soften, ambers are in respect of hardness somewhat damag'd, an instance of which

I have given above from some who work in amber, and who in boiling add to the rape-seed oil a small portion of beef-suet, that the amber may be more tractable, which is thought by them to become but little harder by boiling in oil alone: But this is to be left to their experience, as I cannot adduce any thing like it, or positively affirm it, as my small way of boiling over the flame of a burning fire could not be compar'd with that larger way. Express'd oils in this case differ very much among themselves: and even lintseed oil itself does, either on account of its greater power of emollition, or of its penetrating virtue, soften ambers, as that they seem entirely to have lost their former hardness: Whence it is, that the workmen carefully avoid the adulteration of rape-seed oil with the least part of lint-seed oil. As to the several circumstances of time in which the ambers are boil'd, as also of colour and clearness, they hold, as far as I know, the same in all these oils and fats, unless that in a stronger and more penetrating oil, especially if the regimen of the fire does not exactly answer thereto, the ambers are also more frequently crack'd: Besides, we are not to omit, that one and the same portion of oil, in which ambers were once boil'd, may serve for a second boiling, but not at all for a third.

In this manner I have sufficiently shown the *encheireses* both of nature and art in bringing amber to perfection; so that I think my hypothesis greatly supported both by reasons and experiments. But there remains a considerable difficulty behind; for, as I have shewn that all the other ambers may be clarified, yet the white alone seems refractory to the most careful operations both of nature and art: Whence they have always caus'd the greatest difficulty both to Authors and Artists, but especially to myself: Indeed, as to the more obscure ambers and others charged with foreign contents, and exhibiting an unusual colour, such as are those inclining to black or any dusky or liver-colour, as it is call'd, or such as are blacker, like toasted coffee-beans, I say, as to these and other colour'd ambers of this kind the reason would be obvious, on account of the admixture of many earthy and other heterogeneous parts, why their clarification could not be expected either by art or nature: But that white sort, or only that furnish'd with more solid white *striae* or veins, affords a matter of a higher enquiry: And if they are really incapable of clarification, they seem to throw a cloud on my hypothesis.

White amber cannot be clarified.

But a little more accurately to relate the matter as it stands, it seem'd to me, while I was revolving this difficulty, that the clarification of the white ambers was not to be despair'd of, in regard that the whole assertion was chiefly founded on the authority of the workmen, whose common method of proceeding, if exceeded by one more uncommon, and a longer time were allow'd this sort to come to perfection, some success might, probably, be expected; which as I revolv'd, I at the same time call'd to mind an experiment of *Schroeder*, commended by *Hartmann*^k; or at the least, he does

This farther considered.

‘ does not think it unreasonable, as he confirms, that yellow and clear ambers turn white by a continued boiling for 14 days and 14 nights in a lixivium of *sal gem*, or sea-salt in a strong and earthen cucurbite with a blind still-head.’¹ And this experiment and hypothesis seems likewise to be approved by *Le Mort*^m, who after showing the preparation of the tincture of amber with a highly rectified spirit, digested or distill’d on *sal ammoniac*, he at length adds these words, ‘ that salts effect that, the boiling of yellow amber in common salt manifestly shows, in which the colour is entirely changed, inclining from yellow to white.’ From these experiments I thus infer’d, if we allow that by this *encheiresis* salts may be added to ambers; and thus consequently, that white be produced from yellow ambers, what should hinder me from expecting, that, by such boiling, the salts may also be drawn out of the ambers, and on the contrary, yellow be produced from white ambers; whether that boiling be perform’d in the usual oily *menstruum*, or, which the said experiments rather hint at, in an aqueous *menstruum* and one more agreeing to salts.

But upon making the experiment I found myself disappointed; and first I boil’d white amber in oil, and that repeatedly and for a pretty long time, but in the end I lost all my labour; for, these white ambers remain’d in all respects unchang’d, but the vein’d and variegated, which I had added at the same time, show’d only the obscure dusky portion to be clear, the more solid white *striae* or veins being in no manner discharged, but the flighter veins a little; and in some of this kind, charg’d with obscurity, intermixt with a slight cast of white, a white cloud seem’d to be collected to the centre of the glebe, a manifest sign that it was fixt there so as not to be discharg’d by any attempt.

*Schroeder and Le
Mort's Experi-
ments.*

Thus the experiment in boiling the white glebes in oil proving unsuccessful, we shall now consider *Schroeder's* and *Le Mort's* experiments, that being first acquainted with these, it may previously appear, what we may expect from the coction of white ambers to be clarified in a watery *menstruum*; and to describe them accurately, I must own, that I have taken different sorts of ambers, as clear, yellow and cloudy, that I might carefully observe the change they underwent; including all these in a thin linen rag I design’d them for a continued boiling, which was perform’d in common lee-ashes, us’d with us for washing and scouring vessels; for, it seem’d to me the same thing, or at least that the operation was not different, whether the boiling was perform’d in this salt, which is equally fixt, or in sea or common salt, especially as after a few days new ashes were thrown in, and thus the *lixivium* was never depriv’d of its salt. After that the amber had continued boiling for many days together, I sometimes took it out at pleasure, yet I always found it in its pristine state and in

¹ *Vid. Pharm. Med. chem. lib. III. c. 30.*

^m *In chem. Medico-physica, p. 150.*

in no manner changed, only that in some obscure glebes there appear'd thinner *nubeculae*.

And thus stands that noted *encheiresis* of producing white from yellow ambers; and in whatever manner the process may be set about, I am persuaded the event will be unsuccessful: Whence I scruple not to assert, that in the same manner that operation is to be tax'd, when from this antecedent experiment, as a foundation, after extracting by a watery *menstruum* the salts out of ambers, I gave hopes of the change of the white into clear and transparent amber by means of a watery *menstruum* alone; but tho' it were evident, that these white ambers do not shew more perfect, that is, not transparent, yet that does in no manner lessen the authority of my hypothesis, as I have inferr'd it from so many instances, that all ambers are chang'd into transparent, and made perfect both by nature and art; for, nature works incessantly, and art imitates her, unless as sometimes happens, obstacles intervene, that hinder their good design; for, I would have it known, that all other ambers are compos'd of the better part of sulphur, tho' I would not deny them a slight admixture of salt: Whence these ambers alone more easily undergo this change to the better. But that these white ambers contain much foreign salt in their texture will be allow'd, especially if we give credit to *Hartmann*, who affirms, and discovers large layers both of vitriolic and nitrous salt in the coast of *Sudau*:ⁿ Besides, these white ambers taste saltish by the gentlest touch of the tongue; And all other ambers yield much oil in distillation, but very little salt; on the contrary, the white give a very small portion of oil, but a larger portion of salt. All which things, as they manifestly shew, that this white glebe is not the genuine, certainly not the only product of the amber *matrix*, it will give you the less disgust, if you cannot shew all the requisites, proper to pure ambers, in this impure sort, which contains a great deal of adventitious fixt salt; unless therefore, you would expect, that I should clarify earthy bodies, such as these are, my hypothesis must stand good; for, nature herself, whilst she is employ'd in clarifying and bringing such ambers to perfection, can effect no more than to clarify the distinct obscurer parts, if there are any such, but leave the white untouch'd: yet from this her operation, or if you will, defect, there arise beautiful variegated ambers, so that the curious do with pleasure observe (being assisted herein chiefly by fancy) various kinds of animals, falls of rivers, a tempestuous sea, high mountains, and in fine, plains full of cities and towns, &c. nay strew'd with roses and violets, and partly shaded by the leaves of wide-spreading trees.

Whether producing white from yellow ambers, &c. be practicable.

And thus now I have carefully shewn, that the design of art is the same with that of nature, to wit, the exerting all its force to promote the maturation and perfection of ambers, and this it only accomplishes by procuring them

Whether a variegated white from a pale yellow.

them a clearness and transparency ; her other design is unknown to us, tho' it is notorious, that many changes of colours, by means of fire alone, are devis'd by some, and of this opinion is *Hartmann*,^o but they seem to have no foundation : And first as to the change of the pale yellow into a variegated white colour, expressing the grain of maple wood, I cannot think, that there was ever such a change, at least by means of fire alone ; for, to speak openly what I have learn'd from experiments, I only know this one thing, that the pale yellow ambers, if they be not expos'd to the highest degree of fire, but be rather remov'd before they attain to their total clearness, appear in some manner painted, leaving yellow interstices behind, variously mixing and running into the diaphanous and clear parts ; and this appearance is the more easily obtain'd, if you shift a broader plate of amber over the flame of a candle, in the manner above describ'd, when in a very agreeable manner the clouds of the amber being chang'd up and down, are seen to exhibit different figures ; but whether this shifting colour may be deservedly call'd variegated, and especially a variegated white, and which expresses the grain of maple-wood, I do not see, as a white colour is by no means obtain'd from the pale yellow ambers, unless, previous to the operation of art, it was mixt with them.

Whether a bright white from a whitish.

Nor can we expect greater certainty about the change of the whitish into the bright white, providing we understand that the former are distinguish'd from the latter in this, to wit, that those are white with paleness, but these boast of a greater degree of light and of the brightness of snow and marble. And now it sufficiently appears, that salts, and by means of these, whiteness cannot be added to ambers.

Wavy amber producible from the pale clear.

What has a better foundation is, when *Hartmann* promises himself wavy ambers from the pale clear, providing we have a genuine conception of these last. It seems necessary to me to distinguish (a distinction that will be of use in a great many other places) between the paleness or *albescence* proper to pearly ambers and those of affinity with them, and between the paleness precisely peculiar to the white : The paleness in pearly ambers depends only on their sulphur being well digested and depurated, tho' salts, but those in small quantity and volatile, be added thereto : But the latter paleness, on the contrary, arises from much fix'd salts. Now, therefore, as our author says, that the pale clear ambers are converted into the wavy, these former can be no other than the squamous pearly, that is, such as are furnish'd with slight whitish clouds and interspers'd clear interstices, which, from what was said above, among all other obscure ambers are understood to put on the greatest degree of brightness.

If thus the author interpret the matter, it is well : But when, on the contrary, he supposes, that the whitish ambers may be made from the wavy, he again contradicts both himself and nature and art, whose efforts tend to perfection. But to incline to change the clear and pellucid ambers,

and

^o Loc. cit. L. II. c. 4. § 11.

and especially the wavy, into the whitish and more obscure, would be to bring them from the highest degree of perfection to a lower, and to make them lose all their use, which consists in their clearness.

1. All ambers tend from a state of imperfection to that of perfection. Practical rules.

2. Whence nature and art produce clear ambers from the obscure; but there is no method of producing the obscure from the clear. 3. Ambers with a slighter degree of obscurity are more easily clarified. 4. In perfecting the smaller pieces of amber, the effort both of nature and art is the less. 5. Among the clear ambers the wavy are the principal; among the obscure, the pearly. 6. Obscure ambers, that excell in a greater degree of purity, do also acquire a more excellent degree of clearness, and *vice versa*. 7. Tho' the wavy colour be above all others the favourite, yet next to it the golden colour is not without its praise. 8. Ambers with a golden brightness, you may certainly believe, are the product of nature and not of art, which makes them paler. 9. Whence the wavy ambers, clarified by art, are scarcely distinguishable from those produced by nature. 10. Ambers, boil'd by art, become always harder, nay the earthen pot itself, in which they are boil'd, acquires in time an iron hardness: Hence the fire is the best cure for friable ambers. 11. Ambers full of air-bubbles crack in boiling from the internal air being expanded and seeking an issue. 12. Ambers once committed to the fire, if they have remain'd sound, may be safely recommitted thereto. 13. Ambers, not well freed from their external coat, acquire a coarser after boiling; and even the polish'd, but not all, acquire such a slight coat. 14. Whence crude ambers with a greater coat will be judg'd either clear or pearly, or destroy'd, on account of the greater length of digestion and transpiration allow'd them in the earth. 15. The fire is not always, but sometimes the oil is in fault, that the operation does not so well succeed. 16. Neither is good oil, that has been employ'd twice, proper for a third boiling. 17. Such are deceiv'd, as from perfect ambers hope to obtain the alchemy of ambers; that is, the art of producing great from small ambers.

A new sort of Level. By N. Hartsoecker. *From the Miscellanea Berolinensia. Tom. I. p. 320.*

Translated from the LATIN.

LET the tube AB be so constructed, that the small tubes C and D, Plate V. Fig. 8.
Description of
this Level. the one furnish'd with an eye, the other with an object-glass, may be put in and taken out of both the extremities of the tube AB: Let there be another tube EF somewhat less than the object-glass, suspended in the tube AB in manner of a balance, so as not to touch the tube AB with its extremities; the weights L and M, approach'd to or

remov'd from the centre N of the cross-piece GHIK, fasten'd to the tube EF, will adjust the balance or level: Let a very fine thread, parallel to the horizon, divide both the extremities of the tube EF; and let the tube EF be so exactly suspended in the tube AB, that one thread, touching the centre of the common focus of the eye and object-glass, and running along the axis of both glasses, the other thread may intersect the same axis near the object-glass. That the strongest wind may not mar the use of this level, let it be included in the case OPQR, set on such a base, as that it may be easily turn'd to any point.

The use thereof.

The use of the level will be very easy, and evidently shew its exactness; for, viewing any object, and observing the point which the thread in the centre of the common focus of the eye and object-glass, covers, turn the instrument half round, and shift the places of the tubes CD, in which the glasses are included; and if you find, that the thread in the centre of the common focus of the eye and object-glasses, covers the same point of the object, you will be assur'd, that the tube EF is *in æquilibrio*; but if that thread does not cover the same point of the object, approach or remove either of the weights L or M, as the case requires, till the thread in the centre of the common focus of the eye and object-glasses covers the same point of the object, into whatever end of the tube AB you put the object or eye-glass.

A method of determining either the Quadrature, or the impossibility thereof, in a given figure, terminated by right lines and a geometrical curve. By D. T. From the Acta Eruditorum Lips. An. 1693. p. 433.

Translated from the LATIN.

THAT I may briefly, and at the same time with perspicuity, disclose these things to the skilful in these matters, it is to be noted.

Plate V. Fig. 9.
Construction.

I. Let the space ACB be terminated by the geometrical curve AFB, by the axis AC, and by the ordinate BC: Let now the space ACB be understood to be equal to the rectangle AEDC, as also the space AGF to be equal to the rectangle AGHG: If now the same thing be every where suppos'd, there will hence arise a curve or some line AHD; but this will be either a geometrical or mechanical curve: If the former, the space ACB will both in the whole, as in all its parts, be geometrically quadrable, and therefore I call such a quadrature possible: But if it be any mechanical curve, the space ACB, both as to the whole and all its parts, will be mechanically quadrable, or its quadrature cannot be found geometrically; and, therefore, I call such a quadrature impossible.

II. Now

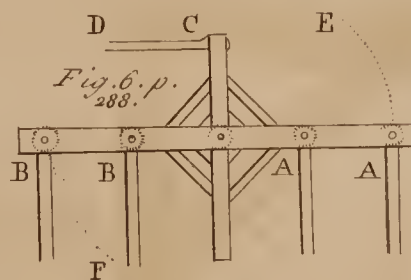
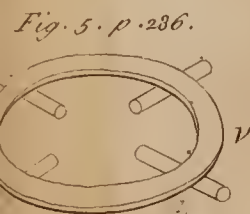
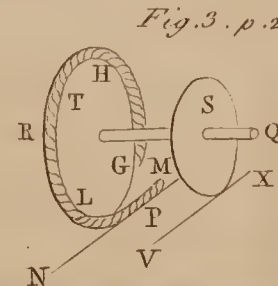
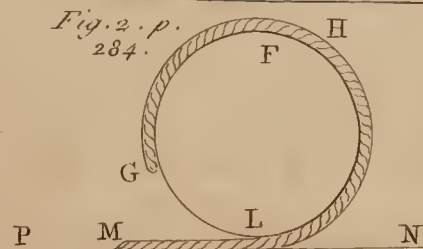
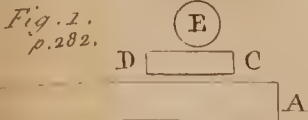
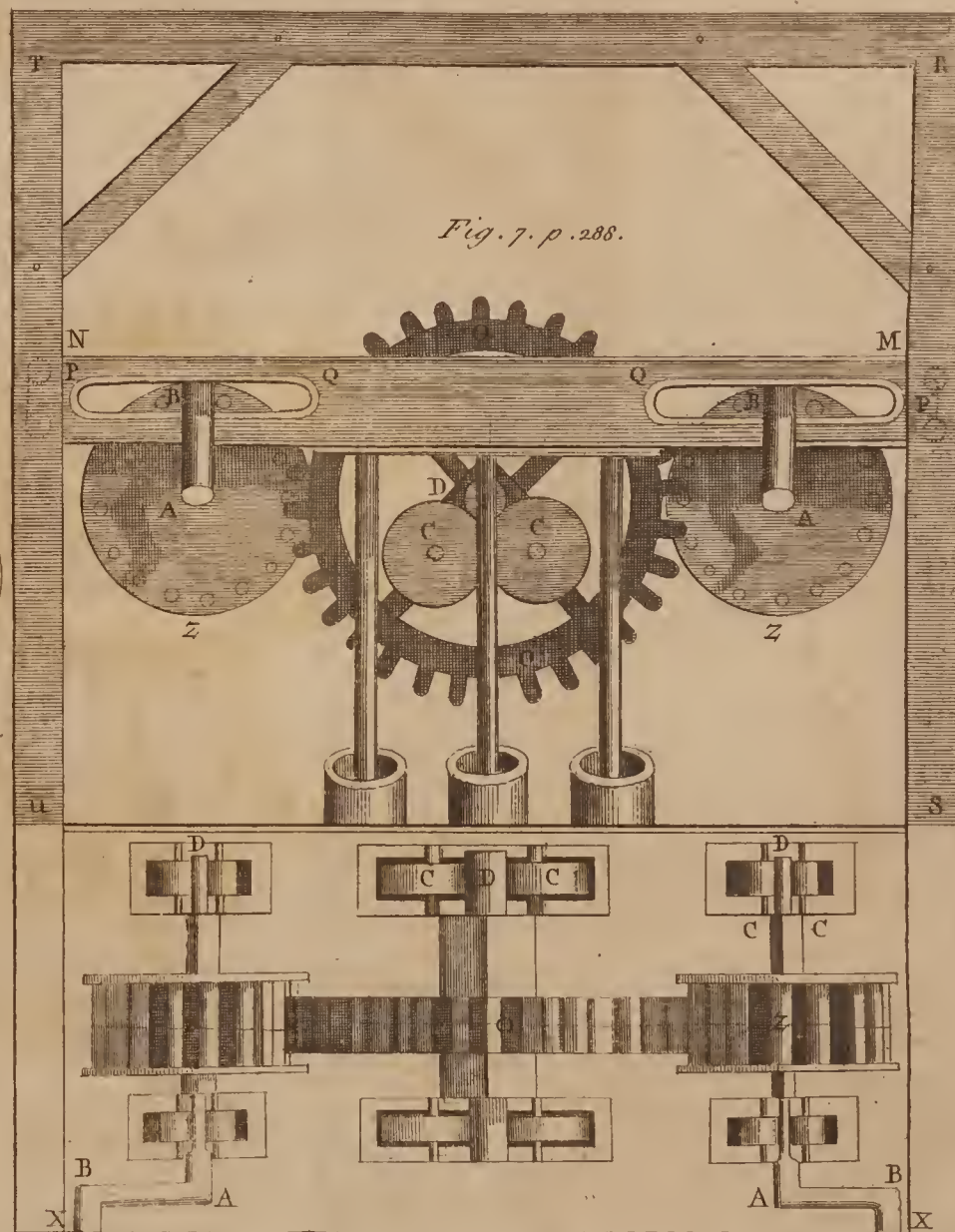
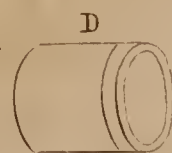
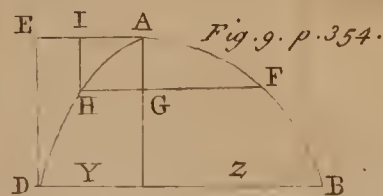
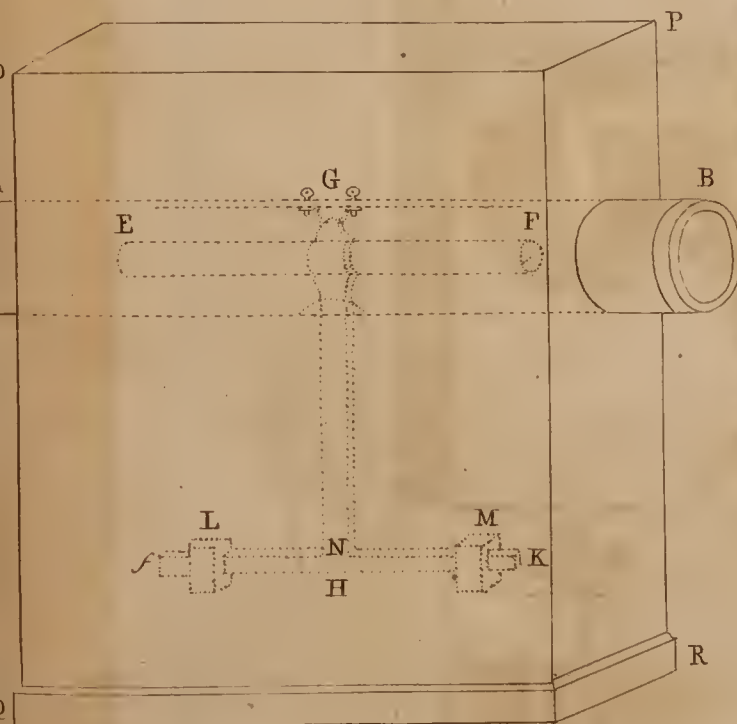


Fig. 8. p. 353.



II. Now let the following equations be form'd

$$\begin{array}{l} by + ca = 0. \quad byy + cay + caa = 0. \quad by^3 + cay^2 + ca^2y + ba^3 = 0. \\ + dx \quad + dxy + fax \quad + dxy^2 + faxy + ia x \\ \quad \quad \quad + gxx \quad \quad \quad + gx^2y + kax^2 \\ \quad \quad \quad \quad \quad \quad + lx^3 \end{array}$$

Equations exhibiting all geometrical curves, and all their possible relations to a right line.

and so on as far as you please.

But we are to observe of these equations, that they exhibit all geometrical curves AHD and all their possible relations to a right line; that x represents all the abscissa's AC, but y all the ordinates CD; $b, c, d, e, f, g, \&c.$ design the known quantities, prefix'd to these terms, with what signs soever they are affected; but the quantity a is instead of unit, in order to make the dimensions equal in all the terms of these equations. But that without a prolix calculus I may explain the following theorems, which demonstrate the quadrature of a given geometrical curve, or the impossibility thereof, let it moreover be

$$\begin{array}{l} c = ca + dx \quad i = ca + 2dx \\ d = ea^2 + fax + gx^2 \quad \text{also} \quad k = 2ea^2 + 3fax + 4gxx \\ c = ba^3 + ia^2x + kax + lx^3. \quad l = 3ba^3 + 4ia^2x + 5kax^2 + 6lxx^3 \end{array}$$

III. Farther let all the abscissa's AC of the geometrical curves AFB be $= x$; but their ordinates BC $= z$; then let it be put

Theorems deduced therefrom.

1. $B = bz + i$ and the first theorem will be $B = 0$

2. $\begin{cases} B = 2bz + i \\ C = cz + k \end{cases}$ the second theor. will be $BBd - BCe + CCb = 0$.

3. $\begin{cases} B = 3bz + i \\ C = 2cz + k \\ D = dz + l \end{cases}$ and the third theor. will be

$$\begin{array}{l} B^3e^2 - B^2Cde + BC^2ce - C^3be + C^2Dbd - CD^2bc + D^3b^3 = 0 \\ - 2B^2Dce + 3BCDbe - 2BD^2bd \\ + B^2Dd^2 - BCDcd + BD^2c^2 \end{array}$$

These things I shall further enlarge on in their proper place, which now I am obliged to omit, in order to avoid prolixness,

IV. Now the use of these theorems is twofold. In the first place, we hence very expeditiously determine all the possible quadratures of geometrical curves; for, assuming any geometrical curve AHD, we immediately find, by means of the theorems just now exhibited, the quadrature of the space ACB, terminated by the geometrical curve: And as the equations in Remark II. exhibit all the curves and all their possible relations to a right line, even by these theorems all the possible spaces, terminated by a geometrical curve, are squar'd; which let it suffice to illustrate by one

Twofold use of these theorems.

First use.

Y y 2

example :

Example.

example: Let the curve AHD be a circle, whose nature is express'd by this equation $y^2 = 2ax - x^2$, or $y^2 - 2ax + x^2 = 0$; now in the equation, which is of the same degree in Remark II.

$$\begin{array}{rcl} by^2 + cay + eaa = 0, & \text{it will } b = 1 & \\ + dxy + fax & & c, d, e, = 0 \\ + gx^2 & & f = -2 \\ & & g = 1 \end{array}$$

Whence in the second theorem $B^2d - BCc + C^2b = 0$ (which is to be chosen, because the assum'd equation is of two dimensions) it will be

$$\begin{array}{lll} c = 0 & i = 0 & B = 2x \\ d = -2ax + x^2 & k = -6ax + 4xx & C = -6ax + 4xx \end{array}$$

All which, if restor'd, there is obtain'd $z^2 = \frac{9a^2x - 12axx + 4x^3}{2a - x}$, explaining the nature of the curve AFB, all whose spaces are squar'd by means of the circle, in regard the space AGF is always equal to the rectangle AIHG. In the same manner a different geometrical curve AHD being assum'd, a different geometrical curve is found, and quadrable: Hence thus it appears, in what manner these theorems include all possible quadratures.

Second use.

V. The other use of these theorems is no less considerable, which is, that a geometrical curve being given, not the quadrature of any other may be found, as was just now explain'd, but either the quadrature of the given or propos'd curve itself be exhibited, or its impossibility demonstrated; which we shall illustrate by two examples; for, in the first place let the nature of the given curve AFB be express'd by this equation

$$zz = \frac{9aax - 12axx + 4x^3}{2a - x}$$

Example I.

Now the question is, whether its quadrature may be given or no? And, indeed, it is plain from Remark IV. that it is given: But suppose that this now is unknown, and observe the process in determining what is sought.

1. Because the ordinate z rises to two dimensions, the third theorem is to be chose (had it had three dimensions, the third theorem was to have been assumed, and so on) but that theorem is as follows

$$BBd - BCc + CCb = 0.$$

2. In this theorem let the quantities B and C , as also b , c and d , be restor'd, and it will be

$$\begin{array}{l} bzz + caz + eaa \\ + 2dxz + 2fax + \\ + 4gxx \end{array} + \frac{dde + ccg + bff - cdf - 4beg \times aaxx}{4bea + 4bfax + 4bgxx} = 0$$

$$- cca - 2cdax - ddx$$

3. Now

3. Now let all the terms of this theorem be compar'd with all those (where x in each case has the same dimension) of the equation which explains the nature of the given curve; and hence there will arise some new equations, by help of which the quantities b, c, d, e, f , &c. will be found: And here b is found $= \frac{1}{2}$, $c, d, e = 0$ $f = -1$ $g = \frac{1}{2}$; all which as they involve no absurdity, the quadrature of the given curve is given; had they included any impossibility, or were they all equal to nothing, the quadrature would be impossible.

4. If now from the equations of the second remark that of two dimensions be assum'd, such as is $b y y + c a p + e a a = 0$ (because the quantity z
 $+ d x y + f a x$
 $+ g x x$

of the given curve also rises to two dimensions) and in this let the quantities b, c, d, e, f , just now found, be restor'd, it will be $\frac{y y}{2} - a x + \frac{x x}{2} = 0$, or $y y = 2 a x - x x$, the property of the curve A H D, by help of which the given curve is squar'd; consequently, it is now determin'd, that the propos'd curve admits of quadrature, and to what known space it is equal. Q. E. F.

For a second example, let the given geometrical curve A F B be a circle, whose property is $z z = 2 a x - x x$; now the question is, whether its quadrature be possible or no? To discover this, as the quantity z rises to two dimensions, we must here use the same theorem, as in the preceeding example: And if now all the terms of the given equation (which expresses the nature of the given curve) be compar'd with all the terms of that theorem, b, c, d, e, f will be found $= 0$; and consequently, there is given no geometrical curve A H D, by means of which the circle may be squar'd; and therefore, the quadrature of the circle, in the sense it is commonly sought for by Mathematicians, is impossible. If the hyperbola be assum'd to be squar'd, the same thing entirely will be found, namely that its quadrature is impossible: But from these things it will abundantly appear, in what manner by help of the like theorems, some of which I have given in Remark IV. either the quadrature of a given figure, terminated by a geometrical curve, may be exhibited, or its impossibility demonstrated (as the same process may be perform'd in all geometrical curves in the manner I have explain'd in these examples) which was my design at this time to disclose. But we are to observe

Example II.

VI. That what I have just now shown is in no manner contrary to the quadrature of the circle and hyperbola, which *Leibnitz* has exhibited * in the *Acta Eruditorum*, An. 1682; for, while the geometrical quadrature of any space is not given, in that case the last resource is to express it by a series

All this consistent with *Leibnitz's* quadrature of the circle and hyperbola.

* Vide ACTA GERMANICA, Vol. I. p. 59. An. 1742.

series of numbers decreasing *in infinitum*: And I am persuaded, that there can be found no arithmetical expression of the quadrature of the circle or hyperbola more simple, than that which the illustrious *Leibnitz* has published. But as to mechanical curves *AHD*, and which seem to be very simple in their nature, that by means thereof the circle and hyperbola, nay all curves, that admit not of a geometrical quadrature, may be mechanically squar'd, I shall exhibit on a proper occasion the method of determining them, when it shall appear, how great an affinity they have with geometrical curves, as their spaces are always equal to the space terminated by a geometrical curve.

Several Chemical Experiments and Observations. By Olaus Borrichius. From the *Acta Hafniensia*, An. 1671, 1672. p. 128.

Translated from the LATIN.

The true tincture
of silver not blue.
Obl. 69.

NOTHING has for a long time been more common than the tincture of silver, but if the matter is rightly considered, nothing is more uncertain; for, that blue colour, which every where, and even in the shops, pleases the eye, is not the genuine offspring of silver, but of such bodies as are mixt with it; for, the purest silver discovers no such thing: The mistake arose hence, namely that it has hitherto been thought by the generality, that silver after the act of fulmination, as it is call'd, or procuring to it in the cupel a splendor or shining brightness, retains no longer any thing foreign and excrementitious, which is a mistake; for, there still remain some minute feculencies (call'd by artists the *lead-sack*) which after repeated fusion and the blast of a hand bellows it scarcely lays aside; but carefully freed of these it neither strikes a blue or green colour in spirit of nitre, *sal ammoniac*, distill'd urine, acids, or other salt liquors: And if it should seem to impart any of these colours, it is a sign of its imperfect purgation; for, a very few grains of copper, lying still conceal'd in silver, tinge many ounces of a liquor and mislead the careless observers: I usually show to the curious such sort of silver, purified by fulmination in a blast-heat, whereby neither acid nor salt spirits are tinged with any blue colour; But neither is that tincture of silver, which is prepar'd from plates of silver and flowers of sulphur, genuine, both because very often some copper lies conceal'd in those plates, however apparently pure, as because the flowers of sulphur are not free from cupreous particles. *Zwelfer* in his *Mantifs. Spagyr.* has, indeed, cautiously hinted about silver, after one act of fulmination, that if the blue colour of the tincture of silver disappears, there is to be added to the remaining abstracted essence a little of a volatile animal salt, that the desired colour may be restor'd: But no such salt can effect, that, if silver be highly pure and free of all recrement,
it

it can put on that spurious colour, as appears from my defecated silver, as in other respects it has all the characters of the most perfect silver; nor does the tincture of the *lapis lazuli* arise from any thing other than from particles of copper floating up and down in its mass, which the sagacious experimenter cannot be ignorant of: Hence I remember the stomach to have been greatly disorder'd from taking both these tinctures in a larger dose, and such as is very well known to be caus'd by copper and vitriol of copper.

Take four ounces of the *regulus* of antimony, grind them in a glass or marble mortar to an impalpable powder, and on this depends the success of the experiments; put this apart in a clean paper; then in the same mortar, after first cleaning it, grind into a very subtil powder, 12 ounces of sublimate; then mix up both powders in a paper, with an oaken or beech stick, no matter which, that they may be well mix'd *per minima*. Put these powder thus mix'd into a small common square glass with a narrow mouth, and continually and strongly compress the powders with the broader extremity of the cold stick, so that the surface of the powder may be every where closely press'd down; and still the powder remains cold, tho' it be press'd for a quarter of an hour; but continue the pressure for a quarter of an hour longer, and at length you will observe the stick, which before reached no deeper than the surface, suddenly sink into the mass and make its way to the bottom: After which gross fumes immediatly arise, the glass is heated, the matter contain'd therein rolls over its brim, frothes and effervesces, sheds over, and fills the whole room with a nauseous vapour; after which you are speedily to convey the vessel without the window, that you may the more securely view the issue of the experiment.

To fuse regulus of antimony without fire.
Obs. 70.

Take four ounces of recent spirit of *Venice* turpentine, yet suffer'd to come to its native coolness, to which pour in a wide glass six ounces of recent and cold generous *aqua fortis*, and shaking the vessel leave it in the open air, and in half an hour, upon removing the cover, the spirit of turpentine, set on by the acid particles of the *aqua fortis*, will begin to effervesce, and amidst thick volumes of smoke emitting a conspicuous flame, and strongly bursting out over the brims of the glass, it will burn: But it is not to be dissembled, that this experiment succeeds better in the noon heat of a summers day, and that it is in vain attempted, unless the spirits be recent; so that hence we may probably not without grounds collect, that in all recent distill'd liquors some fiery and fiercer particles lie conceal'd, and that therefore it is proper to expect their mellowing by keeping some little time, before they are administred to the sick, especially if exhibited as refrigerants. And I doubt not, but that some subtiler substance of fire, or something oily and saline in a vehement commotion (in which nearly the nature of fire is made to consist) bursting out from the wood and coals, penetrates into most chemical vessels, however close, and

To cause two spirits cold to the touch after mixing them to take flame.
Obs. 71.

and leaves some traces of itself behind in the things contain'd in the vessels.

To make fire
pass through the
pores of a glass-
vessel, so as to
produce flame
without hurting
the vessel.
Obl. 72.

I very accurately mix'd 6 drachms of flowers of sulphur with 1 ounce of *East-India* nitre; I put the mixture into a common glass retort, but of a longer neck, and loosely applying, for fear of bursting, a receiver, I gave it a sand-heat, at first moderate, for six hours, afterwards gradually stronger; at length the sand in the iron pot being strongly heated, at first a small flame of a blue colour appear'd in the retort, and immediately a bright flame fill'd the whole glass; the flame at length going out of itself, I view'd the glass after it had cool'd, and it was without any crack, and much of a sublim'd and inflammable sulphur was still observable in the glass, because the flame impetuously rushing, there being only a small hole at the extremity of the nose, was extinguish'd before it had a sufficient quantity of air to consume the whole; nor need you be apprehensive, that this experiment will prove without success, as I never found it to fail, having often tried it in this manner. How far this may serve to illustrate the nature of glass and fire, I leave others to determine.

Of the softness and various contents of Ambers. From the Electrologia of Nathan. Sendelius. An. 1726.

Translated from the LATIN.

Very difficult to
know the genera-
tion of ambers.

THE generation of ambers is a very difficult and arduous subject, of which the more you know, the more still remains to be known. Few things are here discoverable by the senses, as on one hand huge impending mountains, and on the other hand a raging and tempestuous sea bar all access. But to proceed from things certain and known to the knowledge of those that are uncertain and dubious, I shall treat of a subject that comes near to that of the generation of ambers, namely their softness, which, amidst so great darkness, may yield some true and evident postulate, namely 'that the first matter of all ambers is soft and almost fluid', an assertion, tho' it may seem pretty undoubted and unshaken from the many demonstrations, hereafter to be alledged, yet it does not seem to every one so easy, or without exception, but that it may still labour under some difficulties; for, the documents of soft, much less of fluid ambers, are not so obvious, especially, as in our days, they are dug out of the bowels of the earth; on which very thing some reflecting with greater accuracy think they are not entirely without reason, when, being so uncertain about their generation, they affirm, that in the time of the universal deluge ambers were dispers'd up and down: And tho' they do not openly deny their generation, yet they entirely doubt and are quite at a loss how they are generated.

But

But as to this point we have no small number of testimonies, both of the ancients and moderns; and particularly founded upon the authority of these three unexceptionable witnesses, *Goebelius*^a, *Aurifaber*^b and *Wigandus*, and last of all likewise upon that of *Hartmann*^c: And to these we may add the testimony of the authors of *Illustrata Prussia*, *Traët. 6. Containing a relation of a soft piece of Amber, that was found*. And if, notwithstanding all this, such as oppose this opinion, should still continue doubtful, and alledge, either that that was the mistake of these authors, or that they took other bitumens for amber, and if they are not convinc'd by arguments (to be treated of anon more at large) that confirm the original fluid state of ambers, the bare viewing of these glebes, in which one *lamina* is observ'd to lie upon another, must convince them; and certainly such a number of layers will not only argue the original softness of ambers, but that they were form'd successively and at different times; and consequently their continued production and generation.

Testimonies as to their softness.

There is, therefore, no doubt as to the existence of soft amber-glebes, unless the disagreement of some authors should cause a doubt, 'who rather class these soft ambers among rosins than ambers.'

According to *Hartmann* soft ambers differ from the true in colour, taste and odour: "I have seen, *says he*,^d some soft pieces rather like rosins than ambers, their colour the same, namely dusky, somewhat transparent, inclining to red;" without mentioning any thing of the taste, which in other ambers he in some measure found saltish, with a dull sweetness; and in fine, he makes two distinctions of odour, one produced by the attrition of the glebe, another by its deflagration: The former resembled that of other rosins, and like that observ'd in the pieces of pine-rosin, found in ant-hills; but the latter alone was like that peculiar to ambers, as he calls it.

The difference between soft and true ambers, according to *Hartmann*.

What I have observ'd myself on these heads, differs but little from *Hartmann*, except in some circumstances: In these soft glebes I found no taste, tho' I know not whether that found by *Hartmann* be observ'd in perfect ambers, excepting the white or those inclining to whiteness; all which manifestly afford an acid, saltish taste: nor did I perceive a different odour, all of them, both by attrition and deflagration breathing a resinous exhalation, tho' more subtile and grateful in some glebes, in others more disagreeable and gross: From which diversity I think it happen'd, that *Hartmann* has at one time pronounced this odour like that of ambers, at another time like that of rosins. In fine, as to the colours of the soft glebes, I have seen those he describes dusky and but little transparent; I have also

The Author's observation about this difference.

^a De Succin. cap. 4. citante *Hartmanno* Hist. Succ. Pruss. lib. II. cap. 1. § 13.

^b De Succin. cap. 3. citante *eod.* l. c. lib. II. cap. 1. § 15.

^c L. c. Lib. I. cap. 4. § 2. & lib. II. cap. 2. § 6. It. lib. II. c. 5. § 4.

^d Hist. Succ. Pruss. Lib. I. cap. 5. § 1.

seen a clearer sort, nay and sometimes the wavy: And there lately fell into my hands a white soft glebe no harder than stiff wax; this I highly valu'd, as such white soft glebes are the rarer, tho' authors do not entirely omit to mention them, as *Hartmann* shews*. Upon examining this glebe, it was externally white, with some small spaces interspers'd, that were at least obscurely whitish, and inclining to a blush of red: Whereas its internal substance, which I sometimes scratch'd with my nails, and sometimes cut like wax with a knife, was shining white without any defect; it was without any taste, which I certainly expected to be saltish, on account of the admixture of salt in white ambers; and whence their white colour is usually deriv'd, and the spittle acquir'd a white tincture: By attrition it had no odour, nor by a strong friction against a piece of linen, to which it communicated a certain whiteness, but the glebe being set on fire, it both burn'd and breathed an odour, but disagreeable and very noisome, like that of stinking tallow; as was also that, which a piece of it thrown on burning coals yielded, which readily run and boil'd like other pieces of amber, till all its tough and tenaceous fat was consum'd: And tho' all these different *phenomena* held me in suspense, yet I scrupl'd not to class this glebe among the *bitumens*, gather'd with amber, much of which and chiefly of a different kind the Learned allow is found in *Prussia*.

Their different degrees of softness and hardness.

I cannot help mentioning here, that from the frequent observation of these glebes, I met with different degrees of softness and hardness: There was a small one of them of a wavy colour; and therefore much differing from the colours describ'd by *Hartmann*, which by the slightest heat of the hand or by the warm breath could be drawn out every way: And again upon the ceasing of the heat, it recover'd its former rigidity. There were likewise others a little more stiff, that could not be affected by the above mention'd heat, but were comminuted by the teeth into a powder, and continuing the mastication they were again coagulated like mastic, so as to be manageable in the mouth like flexible wax: And there were again others, somewhat harder than those just now mention'd, which when ground by the teeth constantly remain'd in the mouth like a powder without coalescing, tho' they were easily dissolv'd by a slight coal-heat. The wavy sort mention'd above is the most remarkable for its rarity, colour, shining brightness and greater softness, on which, therefore, I made the impression of my seal.

Less solid amber-
glebes referable
to the class of soft
ambers.

To the class of soft ambers are to be reckon'd the less solid amber-
glebes, and so friable, that they may be separated by the least scratch of the nails; and their coction in common seed-oil shews this, in which they are so dissolv'd as to leave nothing solid behind, as I have hinted in another place*, besides cases like honey-combs; but yet if some of these, having a somewhat greater degree of hardness, do bear the fire, they are by means

thereof.

* *Ibid.* Lib. I. cap. 4. §. 2.

* *Vide ACTA GERMANICA* Vol. I. p. 346 *supra.* An. 1742.

thereof brought to a more perfect hardness, and their parts loosely cohering, being united by the fire, they are, as it were, ripen'd.

I had formerly seen in *Breynius' museum* a glebe of no small size, of a dark red colour, exactly resembling toasted coffee-beans. At first, indeed, it yielded to the strokes of the saw, just as other perfect and mature ambers do, and continuing them, and the glebe together with the saw being heated, the passage of the saw became difficult and entirely impeded, and that on account of the gummy substance of the amber being melted, as it were, and clogging the teeth of the saw. I sometimes desisted from the work, and sometimes to remedy it, I likewise sprinkled cold water thereon, and the gummy parts recovering their rigidity, I proceeded; but I had not gone far, when its pristine gumminess return'd, which hinder'd my purpose and design. And from the colour of this glebe, as also from the greater diversity of matter and consistence, it must be one of the rarer sort: And these are almost all the *phenomena* of soft ambers, as they are call'd, according to their different degrees of hardness and other properties, as far as I could discover them from viewing the glebes.

Experiment on an amber-glebe in Breynius' Museum.

It, therefore, sufficiently appears from ocular inspection, that infallible evidence, that there are soft amber-glebes, and that the matter of all ambers is in its first generation fluid. And if the hardest stones were originally fluid, as *Boyle* affirms, that gems were sometime liquid, and in that state ting'd with different colours, we cannot well deny the same softness and fluidity to bituminous and oily matters; but this will appear more from the contents of ambers, to which we now proceed.

That the matter of all ambers is in its first generation fluid appears from ocular inspection.

The contents of amber are various according to the various kingdoms of nature: The animal affords the whole tribe of insects; the vegetable affords its leaves, boughs, tops, seeds, barks and woods; the mineral, in fine, supplies its vitriolic salts, the very mineral wood or *matrix* of amber, metallic *scoriae*, fragments of iron, earths, clays, stones and other things, to all which we must also add water.

From their contents.

All these things afford a very beautiful prospect; but it is a very hard matter to determine in what manner and in what place these foreign bodies are included; and indeed, the only firm bottom on which to proceed is the original liquid state of ambers, by which as the sole cause, we rightly conclude these bodies are included; but where the amber-veins are in a state of fluidity, or where to be sought for remains still an insurmountable difficulty: I know of no one who has been so lucky as to find the amber-glebe liquid in its vein; nay the most ancient diggers never met with any such thing, nor, which is surprising, had any account of it from their predecessors.

Very difficult to determine how and where foreign bodies are included.

It seems very probable, that those liquid and fluid ambers lie deeper in the mountains; and there seems to be no other way of accounting for their animal and vegetable contents than that those parts of the mountains

Probable account thereof.

are torn and broken off by the force of the sea, whereby a passage is opened for insects and vegetables, tho' the parts of vegetables are less rarely found in them than insects; and that large pieces of mountains are broken off and fall into the sea, is confirm'd by the neighbouring inhabitants, who averr, that a great part of the coast of *Sudau* is swallowed up by the sea; and I can confirm the same thing by my own observation: And yet I have had an instance of a fly, included in a glebe of amber, dug out of the earth; nor do ambers lie so deep in the earth, as I myself have observ'd, but that insects may make their way to them, as in the neighbourhood of the village *Groszkubenic*, where the woody vein, together with the amber, lay only at the depth of an ell; and here I found a black beetle; nor is this woody vein more compact than other earths, especially the clayey earth near *Klein Curen*, where a fly was found, but is rather much more soft, so that insects may creep into it in the same manner, as they do into other earths, especially if those concussions of the mountains, mention'd above, should make the passages more patent. That these insects are included in amber within the earth we must infer, as they are of the winged kind, and therefore cannot plunge to the bottom of the sea; nay a spider, upon the experiment lost his life in water, and yet this animal is often found included alive; there would, therefore, remain some marine bodies; and what could be easier than to find sea-weed and moss, which yet are rarely included in ambers. And that these animals, included in amber, are real and genuine, cannot be question'd, as appears from their accurate and perfect delineation, from the impression of the several parts of their bodies, and even of the subtile fibres of their wings: And a single glebe, which I had in my possession, puts this out of all doubt; for, it shows a fly, whose posterior parts only are included, its head with a part of its neck jutting out. Nay, the eggs of insects are to be observ'd, as appear'd from a glebe which contain'd an oblong body, of the bigness of a mustard-seed, and which view'd with the armed eye, shew'd a number of small *animalcula*. That these insects are not chang'd into the nature of amber appears from viewing the glebes, which after opening show the ashes or earthy parts of the animal: Whence it should seem, that they have been included a long time before. And as to vegetables, tho' I allow that something of the amber is deriv'd into their pores and interstices, as they yield the odour of amber, upon throwing them into the fire, yet they still retain their own nature. And as to minerals, that they are corroded by ambers is least of all credible; as their conserving, balsamic virtue seems to hint the contrary; yet, however, as minerals are sometimes observ'd to be corroded, we are to consider, as to their inclusion, that very often, if not always, fissures remain in the amber; nay, some of these irony contents jut out at their sides, and then it is no wonder, if by the sea-water, or other saltish and acrid liquor, or even from the air itself, the vitriol of the iron be dissolv'd, and that corrosion and a natural *crocus* of iron be produced.

produced. And should you suppose iron to be never so well included, and yet after taking it out, it be found to be corroded, there will remain no doubt but that it was so before inclusion.

There remains one question about animals, included in ambers, namely, why insects are only found in clear and transparent, but not in opaque and cloudy ambers? The answer might readily be, that they cannot be seen in cloudy and squamous ambers, on account of their obscurity: And to this it may be answer'd, that there is yearly a twice, nay a thrice greater quantity of obscure ambers clarified, than in that time is clarified by nature and falls into the hands of the workmen. Now if you should ask any of those workmen, whether he ever found any insect in ambers clarified by art? He will readily answer in the negative. When I had carefully applied myself to the solution of this phenomenon, it immediately came into my mind, that, probably, in such a strong boiling in seed-oil, the more tender traces of the animal are obliterated: And to put this opinion to the test, I committed a glebe with a fly in it to the usual cōction for other ambers, and for the usual time and with the usual degree of heat; and after the boiling was finish'd, the fly had undergone no change: But because all obscure ambers are not clarified by one boiling, I made the trial over again, yet still the animal remain'd unalter'd, so that I found my hypothesis not to answer.

A question as to animals included in ambers resolv'd.

As I was casting about for another method of solving this problem, I observ'd and that repeatedly, that the included insects chiefly lodged between the amber-*laminæ* or plates: These *laminæ* I, moreover, considered to be very frequent in the clear and transparent ambers, but very rarely, nay, scarcely occurring in the obscure ambers. From all which observations, as I judg'd all clear ambers to be in their original softness and fluidity highly fluid, as also the most perfect, as I have shown in another place,* but the obscure ambers to be much more tenacious in their original state; hence I thought I had found the reason, why insects are intangled in clear ambers only, but not in the obscure, whose fluidity is more viscid: However, it is not to be entirely denied, that they are not at all, and without exception to be found in the obscure ambers, as I have had two instances of this; one in a very obscure glebe that show'd a large sort of insect, which seem'd to be a beetle, and another in a squamous glebe, with slight *nebulae*, exhibiting, as it were, in the shade, a fly; and therefore, I can give no other reason for the inclusion of insects in clear ambers alone, than their greater degree of fluidity.

Another method of solving this.

Besides animals, vegetables and minerals, there still remains behind to enquire into the inclusion of drops of water, a subject equally worthy of regard, especially as the opinions of authors on this head are different: But to speak my mind freely, the method of including water seems to me equally.

Drops of water how included in ambers.

* Vid. ACTA GERMANICA, Vol. I. p. 341. seq; An. 1742.

equally easy with that of the other contents; for, allowing the primogenial fluidity of ambers, which was just now prov'd, and observing their successive rolling or flux, I easily conceive in what manner another particle of liquid amber may run into a soft amber-glebe, excavated in some part thereof, and include water in its cavity; but whether this water be salt or fresh, is not much to the purpose, in regard it is easy to give instances of both, tho' from my own observation, indeed, I always found it fresh.

An instance.

But to conclude this matter; that these drops of water were included in the first concretion of ambers appears from a glebe which contain'd such a drop; and after the exhalation of the water, some bits of wood (which were moveable, according as you mov'd and turn'd the glebe) remain'd behind: That it had had a drop of water, the appearance of the cavity itself shows, greatly resembling cavities of this kind: And in fine, reason confirms this; for, if you suppose, that those pieces of wood or earth were included in the first concretion of the amber without any water, as the matter of the amber was fluid and soft, they would have, doubtless, been fastened to the glebe, as might plainly be seen in other pieces of this kind in the same glebe.

An Observation of the true Original of the Kermes-grains, of which the purple and scarlet Dyes are made. From the Breslaw Collection, May, 1718. Class IV. Art. VIII. p. 1095.

Translated from the HIGH-DUTCH.

Account of the
purple-dye.

PURPLE-dye was formerly the rarest and the most costly dye of cloth, and us'd in particular by the Roman Senators and Emperors. It had its original from the shell-fish, *purpura*, which bore this purple liquor, included in a vein in its fauces; but which was taken out while the fish was alive, as after its death it was lost: Yet this only happen'd in the larger sort; whereas on the contrary, according to *Hier. Mercurialis*^a, the small sort were pounded, and the juice together with this liquor, was express'd, and for the better preserving of it, put into honey. This dye was first discover'd by means of *Hercules'* dog, who, as he bit a *purpura*, had the hair of his chops dyed with this liquor. The best was taken in *Phenicia*^b: Whence the dye was call'd *color puniceus*; or it was found near *Tyre* and *Sidon*: Whence it was call'd *Tyrius*. Yet it was also found in other parts of *Asia* and *Africa*, and in some parts of the coast of *Greece*. The small shells were call'd *buccinum*, but the larger ones properly *purpuræ*; and they must in particular have been taken in spring. As to their nature, diversity and preparation, *Pliny*^c, but in particular *Fabius Columna*^d, besides several

^a Variar. Lect. lib. 6. cap. 25. p. m. 482, 483.
p. m. 1046.

^c Lib. IX. cap. 36, 37, 38.

^b Scalig. de Subtil. exercit. 325. 14.

^d Tr. de purpura cum not. Joh. Dan. Majoris, Kilæ, 1675. quarto.

several others, may be consulted. At first they dyed violet with it, a pound of which cost 100 *denarii*. Upon this there arose at *Tarentum* the red, and at *Tyre* the most beautiful dye, where the cloth was not only once, as formerly, but twice dyed; and hence usually call'd *dibapha*, a pound of which cost 1000 *denarii*. *Lentulus Spinter*, the Roman *Ædilis Curulis*, began first to wear a *prætecta* thereof; but this was ill constru'd of him: And this was then the red dye, which was got with great labour and in small quantity (whence also its great costliness) from the animal kingdom and from shell-fish: But it was afterwards lost, or it came into disuse, so that almost down to our time this purple-dye may be reckon'd among the *deperdita*, till at length in 1685 it was again discover'd in *England* by Mr. Cole on the sea-coast of *Somersetshire* and the shore of south *Wales* in a certain kind of sea shell-fish^f. Not long ago in *France*, *Reaumur* discover'd a like new kind of purple, which consisted of pure, small, oval-round grains, fill'd with a yellowish liquor, and usually hanging on certain stones, where otherwise the known purple-fish is found in *Poitou*. When these grains are laid on a linen-cloth in the open air, there appear purple, red spots thereon, and these grains are gather'd in harvest, and taken by *Reaumur* for fish-eggs.^g

But whether this purple-dye has been since us'd, we know not; and possibly there will not be so much occasion for it, since there was long ago, instead of this dye, found another beautiful, and also a very costly red dye in the vegetable kingdom, which the scarlet-oak yields, and which in former times was commonly made use of for this purpose, especially in *Spain* and *Portugal*.^h Most people at that time took it for a kind of fruit, by the *Greeks* call'd *κοκκός*, and which, *Dioscorides*, on account of its dying quality, call'd *κοκκός βαφικόν*, that is, the tinging *coccus*, and *Scaliger*ⁱ calls *Scarlatum*, and we usually scarlet: Whence also the tree itself is called *ilex coccigera*. It was formerly found in *Crete* and in other parts of *Asia*, and particularly in *Spain* and *France*, especially in *Languedoc* and *Provence*, where it is still found even at this day: Yet it does not produce universally these grains or *coccus*, but principally on the sea-coast, where the tree is much expos'd to the heat of the sun; neither is it also to be met with on all trees, but only on such as bear no acorns. On which account the inhabitants every four years burn the shrubs, that the following year they may shoot out a-new: And hence they yearly produce on the small shoots the *coccus* in form of smaller ash-colour'd peas, which is gather'd by the children and women, and sold to the merchants, by whom it is prepar'd for the market. By the *Arabs* it is call'd *chermes*, from the *Latin* word *vermis*, instead of which the *Arabs* pronounc'd *gueremis*, and lastly *kermes*^k; by the *Spaniards* it was

A red dye found in the vegetable kingdom.

^e Plin. l. c. cap. 39.

^f Phil. Trans. N° 197.

^g Vid. Hist. de l'Acad. Roy. des

Sciences, An. 1711.

^h Plin. lib. IX. cap. 41. p. 165, — and in particular in lib. XVI.

cap. 8. p. 269. ⁱ l. c. p. 1043.

^k Salmas. Exercit. Plin: p. 676.

call'd

call'd *grana de tintoretos*; and by the *French*, *vermillon* and *graine d'escarlate*¹. Yet this grain is not of itself the true substance of the *chermes*, or crimson-dye, but a small worm lying conceal'd under it; but which is very nimble, in regard that as soon as it comes out of the ripe grain into the free air, it flies off immediately in form of a small fly: Whence you must gather the grains before the insect flies away, as its blood is the proper substance of this dye. The gathering of these grains or of the *coccus*, their nature and preparation are describ'd by *Quiqueranus*^m, *Bellonius*ⁿ, *Eistachius*^o, as also by *Joh. Steph. Strobelbergerus*^p, the *English Philosophical Transactions*^q, and lastly by *Hyacinthus Cestonus* in his *Istoria della grana del kermes*, &c. to be seen in *Vallisnieri Istoria del Camaleonte*, and in an extract of it in Part XXIV. of the *Giornale de' Letterati d'Italia*.

Account thereof.

Now as M. *Garidel* in his *History of the plants growing about Aix and in several parts of Provence*, publish'd at Aix in Folio, 1718, has given a more circumstantiate description of this scarlet-worm, than has hitherto been given, we suppose it will not be disagreeable to the reader to give an extract here of the above-mentioned passage about the *chermes* worms:

‘ In the beginning of *March* there creeps out a worm (which before liv'd
 ‘ in the fields, and is smaller than a millet-feed) into a small tree or shrub,
 ‘ which *Baubin* calls *ilex aculeata cocciglandifera*: It lodges on the trunk,
 ‘ the branches, and ofteneft on the eyes or buds of the tree; and after it
 ‘ becomes gradually stiff and motionless, it begins to grow thicker and
 ‘ thicker from the nourishment it draws from the tree; in that time it is
 ‘ observ'd, by means of a microscope, to be of the most beautiful red, lying
 ‘ in a down, which like a fine wool, curls round about it, and serves it
 ‘ instead of a nest; its figure is convex like half a plum, with several lines
 ‘ round about it: And where no hair or down is found, a great many
 ‘ points shining like gold are to be seen: In the place of the head nothing
 ‘ but a round process is observed, on both sides of which two arch'd,
 ‘ smooth horns, and cut short, stand out, so that the head with its two horns
 ‘ resembles a half-moon; and this may be call'd the first period of the
 ‘ kermes. In the second period, which falls on the middle of *April*, and
 ‘ when this worm attains to its full dimension, it appears round like a pea,
 ‘ sometimes bigger, sometimes smaller; its skin then is much firmer, and
 ‘ the hair or down, which in the first period was only curly, does at this
 ‘ time encompass the whole skin, like a husk or purse, fill'd with a red-
 ‘ dish liquor, like a pale or watery blood. Towards the end of *May* there

¹ Vid. Car. Clusius rar. Stirp. Hispan. l. I. c. 6. p. 33. seq. ^m Tr. de laudibus
 Provincie apud Car. Clusium l. c. p. 36. ⁿ Lib. I. Obs. cap. 17. p. 43. ^o De confec-
 tione alkermes, p. 16, 17. ed. Stetini. Ann. 1635. 4to. ^p Tr. Nov. de cocco baphica
 & confectio alkermes. Jenæ, An. 1620. 4to. ^q N. 20. p. 302. N. 71. p. 2165.
 N. 72. p. 2177. N. 73. p. 2196. N. 76. p. 2294. N. 77. p. 3003. ^r Nouv. de
 la Republ. des Lettres, Art. ult. p. 385—393.

is observ'd on the under part of this husk or purse, or properly under the belly of this insect, small red and oval-round grains from 1000 to 2000 in number: These are the eggs, which are hatch'd by the warmth of the season, and from which a like worm is produced, which lodges in the fields, till the time when nature drives it to betake itself to the above-mentioned tree, and there propagate'. In this curious relation there are several particulars about the *chermes* worm, as also about the eggs, as that they are partly red, partly white, from which there is also produced a two-fold sort of worms, exactly of the form of a moth.

From this observation we may plainly see, that the principal substance of the dye depends on the eggs, as being that red powder, which, according to the relation of *Verney* in the *Philosophical Transactions*^f, is by means of a linen cloth, bolted or searced from the *cocci* or grains; consequently, that they may not creep about or become alive, they are sprinkled with vinegar, and made into balls; but the husks of the grains must be moistened with wine, and set to dry in the sun; and to 100 lb. of this last (which is rubb'd and made bright in a sack) there is mixt from 10 to 12 lb of the above powder, and thus sold: And according to this mixture the price of the *chermes* is higher or lower.

The principal substance of this dye what?

^f N. 20. p. 302.

Reflections on Knowledge, Truth and Ideas. By G. G. L. From the *Acta Eruditorum Lips.* An. 1684. p. 537.

Translated from the L A T I N.

AS at this day there are disputes among excellent persons about true and false idea's; and as it is a matter of great moment to the knowledge of truth, in which neither *Des Cartes* himself has given entire satisfaction, I shall briefly explain what may seem to me to be determined about the distinctions and *criteria* of idea's and knowledge: Knowledge is, therefore, either obscure or clear; and the clear is again either confus'd or distinct; and the distinct, either adequate or inadequate, as also either symbolical or intuitive: And, indeed, if it be at the same time both adequate and intuitive, it is the most perfect knowledge.

The difference and criteria of ideas and knowledge explain'd.

An obscure notion is such, as is not sufficient to distinguish the thing represented, as if at any time I call to mind a flower or animal I formerly had seen, but yet not sufficient, so as to know it again or distinguish it from any thing near it; or if I consider any term not well explain'd in the *Schools*, as the *entelechia* of *Aristotle*, or the cause, as it is common to the material, formal, efficient and final cause, and such like, of which we have no certain definition: Whence also the proposition, into which such a notion enters, becomes obscure: Clear knowledge, therefore, is, when I have characteristics or marks whereby I may distinguish the thing represented, and that is

An obscure notion what?

Clear notion what?

Confus'd notion
what?

again either *confus'd* or *distinct*: Confus'd notion is, when I cannot particularly enumerate sufficient notes or marks for distinguishing one thing from another, tho' that thing has really such marks and requisites, into which its notion may be resolv'd: Thus, indeed, we pretty clearly perceive colours, odours, tastes, and the other peculiar objects of the senses, and we distinguish them from each other, and that barely by our senses, but not by enunciable notes or marks: We, therefore, cannot explain to a blind man what a red colour is; nor can we explain to others what we perceive by our senses, but by bringing them to the thing present, and thereby causing them see, smell or taste the same thing we do, or at least, bringing to their mind some such similar past perception; tho' it be certain, that the notions of these qualities are compounded and may be resolv'd, as they have their own proper causes. In like manner we see, that Painters and other Artists know very well the beauties and defects of any performance, yet oftentimes they cannot give the reason of their judgment, and they tell you, that there is something they know not what wanting in what they

A distinct notion
what?

dislike. But a *distinct notion* is such, as assayers have of gold, namely by means of sufficient notes and trials they distinguish it from all other similar bodies: Such we usually have about the notions common to several of the senses; as for instance, of number, magnitude, figure, as also about several affections of the mind, as hope, fear; in short, about all the things of which we have a nominal definition, which is nothing other than the enumeration of sufficient notes. Yet there is a distinct knowledge of an indefinible notion, when it is primitive or its own note, that is, when it cannot be resolv'd, and can be known only of itself; and consequently, has no requisites. But in compound notions, as again each particular characteristic compounding it is sometimes, indeed, clearly known, but yet confusedly, as gravity, colour, *aqua fortis*, and other things of which the characteristics of gold consist; hence tho' such a knowledge of gold be distinct, yet it is inadequate. But when all that which enters into the composition of distinct knowledge, is again distinctly known, or when the analysis is carried on to the last, the knowledge is adequate; of which I know not whether it be possible to give a perfect example; yet the knowledge of numbers comes very near it. And for the most part, especially in a more prolix analysis, we do not at once view the whole nature of the thing, but instead of the thing make use of signs, whose explication in any present thought we for brevity's sake usually omit, either knowing or believing, that we have it in our power: Thus, for instance, when I think of a polygon of a thousand equal sides, I do not always consider the nature of a side, of equality and of a thousand, or the cube of 10, but in my mind I use these terms (of whose meaning I have only an obscure and imperfect idea) instead of the ideas I have of them, because I remember, that I know the meaning of these terms, but do not now think the explanation

A blind or symbolical knowledge what?

cation of them necessary; and this knowledge I usually call a *blind* or even a *symbolical* knowledge, which we use both in algebra and arithmetic, nay, almost every where. And indeed when a notion is very compounded, we cannot at the same time think of all the notions entering into its composition: But where we can do this, or at least in so far as we can do it, I call that knowledge *intuitive*. We have no other knowledge of a distinct primitive notion than what is intuitive, as for the most part the notion of compounds is only symbolical.

Intuitive knowledge what?

Now from these things it appears, that we do not perceive the ideas of those things, which we also distinctly know, but in so far as we use intuitive thought; and indeed it happens, that we often falsely believe, we have ideas of things in our mind, when we falsely suppose, that some terms we use have been already explain'd by us; nor does it hold true, or at least, it is subject to ambiguity what some affirm; *viz.* that we cannot speak of any thing intelligibly without having an idea of it; for, we often in some measure understand each term or we remember we understood them before, yet because we are satisfied with this blind thought, and do not sufficiently pursue the resolution of the notions, it happens, that we lose sight of the contradiction, which probably the compound notion involves. What gave me a handle more distinctly to consider those things was an argument long famous among the Schoolmen, and reviv'd by *Des Cartes*, for the existence of God, and which is as follows; what thing soever follows from the idea or definition of a thing, that thing may be predicated of it; existence follows from the idea of God (or the most perfect being, or a being than whom no greater can be thought of; for, the most perfect being involves all perfections, among which existence is one) existence therefore may be predicated of God. But we are to know, that hence it only follows, if such a being as God be possible, it follows that he exists; for, we cannot with safety use definitions for making inferences, before we know that they are real, or that they imply no contradiction; the reason of which is, that opposites may at the same time be concluded about notions involving a contradiction, which is absurd: And to clear this I usually employ the instance of the swiftest motion, which implies an absurdity; for, let us suppose any wheel to revolve with the swiftest motion; any one sees that any spoke thereof being produced will with its end move faster than a nail in the circumference of the wheel; its motion, therefore, is not the swiftest, contrary to the hypothesis: It may however at first sight appear, that we have an idea of the swiftest motion; for, we in some measure understand what we say; and yet we have no idea of impossibilities: In the same manner, therefore, it is not enough to think of the most perfect being, that we can assert we have the idea of him; and in the demonstration above alledged, the possibility of the most perfect being is to be either shown or suppos'd, that we may form a right conclusion: However,

The perception of the ideas of things we distinctly know, is only by intuitive thought.

nothing is truer than that we both have an idea of God, and that the most perfect being is possible, nay necessary; yet the argument is not sufficiently conclusive, and has been rejected by *Aquinas*.

Distinction between nominal and real definitions, and there- by *Hobbes*' objection answer'd.

A true and false idea what?

And thus we also have the distinction between nominal definitions, which contain only the notes of a thing, which is to be distinguish'd from others, and between real definitions, from which it appears, that the thing is possible: And in this respect we give an answer to *Hobbes*, who would have truths to be arbitrary, because they depended on nominal definitions, not considering, that the reality of a definition is not arbitrary, nor that any notions at pleasure can be conjoin'd; nor are nominal definitions sufficient to a perfect knowledge, unless when it some other way appears, that the thing defin'd is possible. In fine, it is also manifest what a *true idea* and what a *false* one is; namely, an idea is true, when the notion is possible; false, when it implies a contradiction: But we know the possibility of a thing either *à priori* or *à posteriori*; and indeed *à priori*, when we resolve a notion into its requisites, or into other notions of a known possibility, and in which we know there is nothing incompatible; and among other things this happens, when we understand the manner in which a thing may be produced: Whence above all others, *causal definitions* are of use; but *à posteriori* when we experience the thing actually to exist; for, what actually exists or existed, that thing is possible: And indeed, whenever we have an adequate knowledge, we have also the knowledge of possibility *à priori*; for, after compleating the analysis, if there appear no contradiction, the notion is possible: But whether a perfect analysis of notions may ever be accomplish'd by men; or whether they can reduce their thoughts to the first possibilities, or into irresolvable notions, or (which comes to the same thing) into the absolute attributes of God, namely the first causes and ultimate reason of things, I cannot now, indeed, venture to define; for the generality we are content to have learn'd by experience the reality of some notions, whence we afterwards compound others in imitation of nature.

An appeal to ideas not always safe.

Hence, therefore, in fine, I think it may be understood that it is not always with safety we appeal to ideas, and that many abuse this specious title to establish some of their own imaginations; for, we have not immediately an idea of a thing, of which we are conscious we think, as I have shewn above from the instance of the greatest velocity: And I no less observe that men in our days abuse this boasted principle, namely *that whatever I perceive clearly and distinctly about any thing, such is true and enunciable of it*; for, often things seem clear and distinct to men, who judge rashly, which are really obscure and confus'd; the axiom, therefore, is of no use, unless the *criteria* of clear and distinct, which we have given, be employ'd, and unless the truth of the ideas be establish'd. As to the rest, the rules of common logics, and which Geometricians also use, are

no

no contemptible *criteria* of the truth of enunciations; namely, that nothing be admitted for certain, unless it be prov'd by accurate experience or firm demonstration: But firm demonstration is such as keeps to the form prescrib'd by Logicians, not that in the manner of the *Schools* there is always occasion for formal syllogisms (such as *Christianus Herlinus* and *Conradus Dasypodius* have employ'd on the first six books of *Euclid*) but that at least the argumentation conclude by virtue of its form; and you may say, that any just calculus is an instance of such an argumentation and form; and therefore, no one necessary premiss is to be omitted, but all the premisses should either be previously demonstrated, or at least assum'd as hypotheses; in which case the conclusion is also hypotheticalal. Such, as shall diligently observe these things, will be easily on their guard as to deceitful ideas. And agreeably to this the ingenious *Pascal*, in his excellent dissertation *de ingenio geometrico* (a fragment of which is extant in *Arnaud's* treatise *de arte bene cogitandi*) says, that it is the part of a geometrician to define all the terms that are *any thing* obscure; and prove all the truths that are *any thing* doubtful: But I could wish he had settled the limits, beyond which any notion or enunciation is no longer *any thing* obscure or doubtful. Yet what may be proper in this case, may be drawn from an attentive consideration of what I have said, as I now avoid prolixness.

As to that controversy, namely whether we see all things in God (which is an ancient opinion, and if taken in a sound sense not entirely to be despis'd) or whether we have proper ideas, we are to observe, that tho' we saw all things in God, yet that it is necessary we have proper ideas, that is, not a sort of images, as it were, but affections or modifications of our mind, answering to what we perceive in God; for, by our different successive thoughts there is some change made in our minds; but the ideas of things not actually thought on by us are in our mind, as the figure of *Hercules* in a block of marble: But in God it is not only necessary, that there actually be the idea of absolute and infinite extension, but of any figure, which is nothing other than a modification of absolute extension. Besides, when we perceive colours, or odours, we have no other perception than that of figure and motion, but so manifold and minute, that our mind in this its present state is not sufficient to consider each distinctly; and therefore, does not advert, that its perception is compounded only of the perceptions of the minutest figures and motions; just as in perceiving a green colour, upon mixing together yellow and green powders, we perceive nothing but yellow and blue very minutely mixt, without adverting thereto, and rather framing to ourselves some new being.

Whether we see
all things in God,
or whether we
have proper ideas
explain'd.

Of the Mensures or Laws of the Forces of Bodies. By M. I. Hermann. *From the Commentarii Academiæ Scientiarum Imperialis Petropolitanae* Vol. I. Sept. Ann. 1725. p. 1.

Translated from the LATIN.

The force of a body what. 1. **T**HE force of any body, as all writers in mechanics are agreed, denotes *the power of effecting motion*, either in the very body itself, wherein this power is understood to exist, or in other bodies, different from it: For, no body really at rest can have such a moving power, but is only endued with a *vis inertiae*, whereby it resists the force acting upon it.

What is meant here by a body really at rest.

2. We are here speaking of a body really at rest, and by this we understand not simply that which is only apparently at rest, but rather that which is destitute of all *conatus* to motion: For, there are bodies, which tho' they do not actually move, yet have a *conatus* to motion; but this *conatus*, on account of interposing impediments, is ineffectual. Thus, a heavy body, insisting on any horizontal plane, is indeed apparently at rest; because the plane on which it is hinders its descent; but it is not, therefore, truly at rest; seeing it has a *conatus* of descending, which will break out into an actual descent, as soon as the plane hindering the descent of the body, shall have been remov'd.

Dead and living force what.

3. There is, therefore, a wide difference between a power which produces an actual motion, and a power, which only terminates in a simple *conatus*: For, this last is only a *dead force*; but the other is call'd a *living force*; a body, therefore, hanging by a thread, or insisting on any plane has only a dead force; but if it actually moves, then it shall be said to have a living force.

Mechanics entirely conversant in the invention of measures for estimating the dead and living forces.

The whole doctrine of mechanics is conversant in the invention of proper measures or laws, according to which both the dead forces of bodies and their living forces, may be rightly estimated: From which it appears that the true doctrine of forces is of some importance; and consequently worthy to be carefully and cautiously cultivated. But tho' there are no disputes about the *dead forces*, as about the *living forces*; yet I shall begin with the former.

The measure of dead forces what.

4. As to dead forces, therefore, and their measure; this measure easily discovered: For, by a small degree of attention it will be manifest that the weight of any body is the measure of its dead force; and in so far as this force flows from the principle of gravity: I have added this restriction, because there is another species of a dead force in bodies, which flows not from the principle of gravity; and of this kind of dead force are the centrifugal forces of revolving bodies. For, as often as any body does, with an uniform or even with any degree of variable motion, describe the per
phe

phery of a circle or other curve, in each moment of this motion it will endeavour to pursue its motion in the direction of the tangent of the circle, or curve, in that point wherein it is: In each moment, therefore, the body endeavours to recede from the circumference of the circle, or from the curve, in the direction of a perpendicular to the tangent, passing thro' the centre of gravity of the body, but as often as the body cannot really recede from the circumference of the circle, or curve, and has only a *conatus* of receding, this *conatus* is the dead force: For, the centrifugal *conatus*'s may be compar'd with gravity; the centrifugal forces, therefore, and gravity, are homogeneous quantities: Now the dead forces, of whatever species they are, are proportional to the masses of the bodies, *cæteris paribus*; that is, if the gravity in both bodies be the same, or if both bodies move with an equal celerity in equal circles: This is very easily prov'd; let two unequal bodies, the lesser A, and the greater B, rest upon any horizontal and immoveable plane; both will exert so much force upon the plane, as is proportionable to their weight; because this plane is immoveable, and directly opposes the descent of both bodies; but the weight of the greater B is to that of the lesser A, as the mass of B, to the mass of A; and this is generally allow'd; therefore, the dead force of the body A, is to the dead force of the other body B, as the mass or quantity of matter of A, to the mass of B: The case, therefore, holds thus: with the dead forces depending on gravity; and the same may be easily shown as to those which flow from the centrifugal forces: For, because by the hypothesis, both bodies A and B revolve with equal celerity in equal circles; if B have a greater centrifugal force than A, that is owing to the mass; therefore, so many times as the centrifugal force of B is greater than that of A, so many times is the mass of B greater than that of A; therefore, it is, as the dead force of B, flowing from its centrifugal force, to the force of A, so the mass of B, to that of A.

In the like manner it may be shown, that if the intensity of gravity in different bodies, or the intensity of the centrifugal force of bodies, revolving in different circles, be different, the dead forces will be in the compound ratio of the masses of the bodies, and the intensities of gravity, or the centrifugal forces of the bodies moving in circles. By the intensity of gravity, or of the centrifugal force, I understand the gravity or weight: which a body, whose mass is as 1, has at different distances from the centre of gravity; or the centrifugal force, which the same body has in the different states of its circular motion: So much for the dead forces.

5. But what ratio the dead force has to the living is a question the most approved authors answer by affirming, that the living force is infinite in regard to the dead force: And what *Galilæo*, *Torricelli*, *Borelli* and others have said of this matter, deserves to be perused: Who all of them have endeavour'd to prove both by experiments and reasonings, that the force

The ratio of the dead to the living force.

of

of percussion is infinite, if compar'd with the simple weight or gravity of bodies: I think it needless to transcribe their arguments, seeing they may be read in their works; and that there is no dispute on this head among the intelligent: I shall, therefore, here only hint, that these excellent philosophers would have express'd themselves more accurately, if they had said, that the force of percussion and the gravitation of bodies were heterogeneous quantities; and consequently, incapable of comparison: As *Des Cartes** has spoke of thole sorts of forces, in a letter to *Mersemus*, where he expressly writes, that the force which is sufficient to raise a weight to any height *has always two dimensions*; but that force, which is sufficient to sustain the weight in any point of this height, *has never more than one dimension*: So that these forces differ from each other as superficies and line; and are therefore incapable of *ratio*. The same may be said of the force of percussion, and the gravitation of bodies: For, the former is the living, but the latter is the dead force. What we have only briefly said in this paragraph, will be more clearly prov'd in the following paragraphs, after that we shall have treated of the law of the living forces.

Diversity of opinions about the ratio of the living forces to each other.

6. All are not agreed in opinion, as to the ratio of the living forces to each other: For, the generality own, that these forces follow the ratio of the impetus of bodies, or of their quantities of motion, that is, that the living forces of two bodies are in the compound ratio of the masses and celerities: And in this almost all the writers in mechanics seem to agree; but those who fall in with the notion of the illustrious *Leibnitz* swerve a little from this, and hold, that the living forces are in the compound ratio of the masses, and the duplicate ratio of the velocities of the bodies: This proposition M. *Leibnitz* first inserted into the *Acta Eruditorum*†, and he deduced it from a twofold principle. 1. *That every heavy body, abstracting from every external impediment of motion, does, by falling vertically, acquire a force of ascending to the same height from which it fell.* 2. *That the force necessary to raise the body A, of one pound, to the height of four yards, is precisely equal to that force, by which another body B, of four pounds, may be rais'd to the height of one yard.* From which it was easy for him to conclude, that the forces of bodies are as the products of their masses into the squares of their celerities: But the certainty of this conclusion depends on that of the principles; the first of which no one denies; and the second also with this restriction, *if the times of ascent be equal*, is universally admitted: In this sense at least the Abbè *Catelan*^a, who undertook to defend the *Cartesians* against M. *Leibnitz*, admits of the second principle; yet pretending, that it was wrongly applied by M. *Leibnitz* to bodies, which absolve their heights in unequal times: since it agrees only to isochronal motions, when applied to the five mechanical powers: For M. *Catelan* and others would understand this *Cartesian* principle of isochronal motions

*Epist. 74. part I. † An. 1686. p. 161. ^a *Nouv. de la Rep. des Lett.* An. 1686. p. 577

motions, on the account only of converting the spaces describ'd by the bodies into their celerities, and making the forces of the bodies proportional to their quantities of motion: For, in uniform and isochronal motions, the celerities are as the spaces; but *Leibnitz* clearly shows,^b that there is no necessity for considering the time in estimating the forces of bodies; and *Des Cartes* himself,^c who makes use of this principle, says, *that neither a greater nor a less force is requisite to raise any body to a certain height, than to raise another less heavy body to a height so much greater, as itself is less heavy; or to raise another heavier body to a height so much less.* He makes no mention of the time, tho' he has applied it to the mechanical powers, in which the motions are isochronal: Nay, in the following letter he expressly hints, *the first thing wherein one may be mistaken in this affair is, that most people usually confound the consideration of the space with that of the time or celerity:* Where he immediately subjoins; *Thus in the lever or balance, supposing that one arm is double the other, and the weight, hung to the shorter arm, is also double that suspended to the longer arm; so that they may be in æquilibrium: Where we should say, that the cause of this æquilibrium is, that if the greater weight should raise the lesser, or be rais'd by it, then that greater weight would only pass over half the space of that which the lesser passes over; they affirm, that it would move twice slower; which error is of so much the worse consequence, as it is the harder to discover.* *Des Cartes*, therefore, would seclude the consideration of the time or celerity from that of the space in estimating the living forces; and in this very thing he pretends, he has shown more art than in any other part of his Statics: *Des Cartes*, therefore, agrees in some measure with *M. Leibnitz*.

7. The common opinion, that the living forces are as the *impetus* of the quantities of motion of bodies, seems to be founded in a principle, that cannot well be contested, but is ill applied; to wit, in this axiom, that effects are proportional to their adequate causes. Most people at least deduce the common estimation of the forces from this axiom: For, if the force of any body be its power of effecting motion, this power will come to be consider'd as a cause, and the motion produced, as an effect; wherefore, a double, triple, &c. power will produce a double, triple, &c. motion: By this means, therefore, the living forces of bodies would be as the quantities of motion, or the *impetus*: It does not then appear, why these very forces should be as the products of the masses of the bodies, into the squares of the celerities, as *M. Leibnitz* has taught us.

Objection that the living forces are as the impetus of the quantities of motion.

8. We allow that this argument is specious; but not the truer for all that: We allow *that causes are proportional to their effects*: For, this rightly understood, and duly applied, cannot only not be denied, but even *M. Leibnitz* himself admits it in other words, when he says, *that there is*

Answer'd.

^b *Nouv. de la Rep. des Lett.* An. 1687. p. 131.

^c *Epist.* 73. Part 1.

an inviolable equality between the plenary cause and the entire effect: For, in reality, a cause is so far a cause as it produces its effect; so that the effect and cause which produced it, are equipollent; and if so, in what *ratio* the cause is augmented or diminish'd, in the same *ratio* will the effect be likewise increas'd or diminish'd: But we deny, that the motion of the body, or the *impetus*, in so far as it is express'd by the products of the mass into the celerities of the bodies, is an entire and adequate effect of the acting power; but rather that the heights, or spaces, thro' which bodies may ascend, should be assumed for the measure of the effects, which the powers, acting upon these bodies, can produce; nor according to *Des Cartes* himself are these spaces to be confounded with the celerities or times: For, the celerities are only modal and incomplete *entia*, otherways than the spaces which the bodies pass over in their ascent: Besides, effects, expounded by the quantities of motion, are not capable of an accurate measure: For, the genuine law of measuring requires, that the measure be precisely contain'd once or more times, or be repeated once or more times in the things to be measur'd; but this does not evidently hold in bodies moving with different celerities: For, tho' I own, to use *M. Leibnitz's* example, that three equal bodies and with equal velocities have precisely thrice more power than one of them; because one and the same measure is repeated here three times (for, a body of a certain quantity, equal to each apart, is repeated thrice) yet it cannot, therefore, be immediately granted, that a body with three degrees of velocity contains three times a body equal to itself with one degree of velocity; because in this latter case the common measure is not repeated in the same manner in the greater quantity, as it was repeated in the first case: For, in this, the substantial *ens*, that is, the body with one degree of velocity is repeated three times; but in the other instance, the celerity, which is a modal and incomplete *ens* of one and the same substantial thing, or body, is repeated three times: Wherefore, in these two examples, the less is not contain'd in the greater after one and the same manner.

A contradiction according to *M. Leibnitz* in estimating the living forces by the quantities of motion.

9. *M. Leibnitz*, moreover, in many places of the *Acta Eruditorum** shows, that there is a plain contradiction, or absurdity, in estimating the living forces by the quantities of the motion of bodies: For, he supposed any ball A to have fallen vertically from the height of one foot, and with the velocity acquir'd at the end of this height, continuing in equable motion in a horizontal plane to have impinged on the quiescent ball B, $\frac{1}{4}$ thereof, or subquadruple thereof; and to have transfer'd all its motion and force to it: So that the ball B shall by this shock have acquired four degrees of velocity, and according to the common system shall have obtain'd a force equal to that of the ball A in its fall from a height of one foot. *M. Leibnitz* next shews, that when the ball B, changing the motion, acquired

* *An.* 1690, p. 235. *An.* 1691, p. 439. *An.* 1695, p. 156, &c.

acquired from the ball A vertically upwards may rise to the height of 16 foot; by means of a lever it may raise the ball A to a height upwards of three times greater than that to which the same ball A could have risen with the force, which it had acquired by the fall from a height of one foot. Now the absurdity and contradiction consists in this, we have two bodies, of which A has the mass as 4, the celerity as 1; the other B the mass as 1, but the celerity as 4; which are made equal to the forces, when yet the ball B with its force can raise some body equal to the other A to a height greater than three feet; but the body A has only the force of raising itself to the simple height of one foot: Wherefore, the body B at one and the same time has a force greater than and a force equal to that of the body A.

M. Papin, against whom M. Leibnitz had urged this argument,* had no other answer to make than that it was naturally impossible that the motion of the ball A could be transfer'd to the other B at rest: But when M. Leibnitz had afterwards shown how this could be done, and taken in the consideration of the lever for that purpose; Papin excepted, *that there were no levers perfectly rigid and inflexible*; But the force of the argument is not so easily eluded; for, granting that the motion of any body cannot be transfer'd into another unequal body; and likewise allowing that there is no such thing as a rigid and inflexible lever, the argument will lose nothing of its force: For, it is possible, that the balls A and B, which in respect of their masses are in a quadruple ratio, may have equal quantities of motion; and that without the supposition of the motion of the one passing into the other, or that there are rigid and inflexible levers: It is, therefore, possible, that the lesser ball B changing its motion upwards may rise to the height of 16 foot; and if so, we must own, that the ball B may raise the ball A to the height of better than three foot, whether there be any such thing as a perfectly rigid and inflexible lever, or no: M. Leibnitz's argument therefore stands good, notwithstanding M. Papin's objections.

From what has been said I think it in some measure evident, how unsafe it is to estimate the forces of bodies by the quantities of motion; and that the more, that Des Cartes himself^d has on this subject excluded the consideration of the celerity, when among other things he says, *we can say nothing well and solidly on the celerity, before we have first rightly explain'd gravity, and at the same time the whole system of the world*. But tho' the Moderns have now a somewhat different opinion about this proposition; yet it is evident from it, that Des Cartes did not think it necessary in estimating the forces to attend to the celerities, but rather to the resistences, which the bodies have to overcome, as it appears expressly in the same letter.

M. Papin's answer.

The forces of bodies not to be estimated by the celerity, but rather by the resistences.

* loc. cit.

^d Epist. 74. part. 1.

The adequate
and real effects
of the living for-
ces what?

Gravity an im-
pediment, and
how the resistance
arising therefrom
is measur'd.

10. Because, therefore, the quantities of the motion of bodies are not entire and plenary effects of the powers acting on the bodies, we must not thence infer, because causes are proportional to their adequate effects, that the living forces of bodies are proportional to the quantities of their motion, as is generally supposed; and for this reason it remains to be discover'd, what then are those adequate and real effects of the living forces? Now *Des Cartes* himself has long ago in the above letter pointed at these real effects, when by the bye at least he orders to attend to the resistences to be overcome by the ascensional forces: For, by this means we have effects fit to measure the forces; for, this proposition, *that all the impediments of motion, which taken together do extinguish any force are equal to that force*, seems to be as clear and certain as any axiom in geometry; and it comes to the same thing as saying, *that all the parts of any whole and that whole itself, are equal*: For, each impediment takes away so many parts from the force of the body; and together, the whole force. It, therefore, remains to be enquir'd, what these impediments are, which exhaust the forces of bodies: Now gravity itself is such an impediment; for, every one knows, that any body thrown vertically upwards with a given celerity does not continue its motion *in infinitum*, but reaches only to a certain height; but it ought to ascend *in infinitum*, if it met with no resistance and impediment to its motion; consequently, from its reaching only to a limited height, which it cannot exceed, we must necessarily conclude, that that is owing to the resistences it ought to overcome in its ascent; but these resistences arise not only from the air encompassing the ascending body, but especially from gravity; for, should they arise from the air alone, that body ought to ascend to any height at pleasure in very rare air: which as it does not happen we must conclude, that the said height is an undoubted proof of the resistance the body finds from gravity; for, gravity is that force whereby bodies tend continually towards the earth; wherefore, this force, as being contrary to the ascensional force, comes now to be consider'd as a resistance: This, if I mistake not, is so evident, that it seems to require no farther proof. But, perhaps, it will not appear so evident, how this resistance arising from gravity should be measur'd? Nevertheless any one who attends, that the ascending body does in each point of the height it describes equally gravitate towards the earth, cannot but see, that the sum of the resistences to be overcome by the ascending body is very well expounded by the product of the height of the ascent into the weight of the body; and as this sum of the resistences (by what has been said above) is equal to the force of the body in the beginning of its ascent, it is plain, that even this *living force* is to be measur'd by the product of the height to which the body ascends into the weight of the same body. But should this, notwithstanding, seem to be not sufficiently evident and undoubted to such as give in to the contrary opinion,

opinion, I shall give a fuller demonstration of this matter below. But now I proceed to other things.

Among a great many other impediments to motion, this likewise, which is taken from equal springs and equally bent, is adapted to measure the forces. *Job. Bernouilli* has long ago shown, that any body A, having two degrees of celerity, exhausts its force on four similar and equal springs equally bent, while the same body A, having 1 degree of celerity, exhausts its force on one spring only equally bent; but such equal and equally bent springs are the adequate effects capable of an exact measure, which those forces of the body A, having at one time 2 and at another time 1 degree of celerity, can produce; but because the effect of a swifter body is to that of a slower, as 4 to 1, it is, therefore, manifest, that these effects are in a duplicate ratio of the celerities. *Bernouilli's* own argument, which here for brevity's sake I omit, may be seen in *Wolffius' Element. Mechanicæ* ^c. In a yet different manner *s'Gravesande* has in his *Element. physices* ^f deduced the same thing from the theory of springs.

Springs another impediment, and how adapted to measure the forces.

11. The same measure of forces may be had from the laws of motion obtaining in the collision of bodies, as I have already shown many years ago. Let the ball A having 2 degrees of celerity and moving in an horizontal plane, impinge upon another ball B = 3A but at rest; it will, therefore give this a celerity as 1, and A will retrocede with the celerity 1; afterwards let this ball A impinge with its celerity 1 upon another ball C = A, that is also at rest, it will likewise give it a celerity 1, and its motion will be stopp'd by this second impulse: And all this is very easily found from the known laws of the motion of elastic bodies. Here, therefore, we have the ball A, which, by two impulses upon each of the balls at rest, viz. B = 3A and C = A, transfusing, so to speak, the same celerity, is reduced to a state of rest and loses its force; it, therefore, produced the same effect, as if it had communicated the celerity 1 to the ball D = 4A = A + 3A; and the same ball A with the celerity 1 will by one impulse also communicate the velocity 1 to another equal ball, and be reduced to a state of rest; the effect, therefore of the swifter ball is to that of the slower as 4A to A, that is as 4 to 1. On this account the force of the swifter is to that of the slower, as the square of the celerity of the greater to that of the celerity of the lesser.

The measure of forces obtain'd from the laws of motion in collision.

And the case is the same with the same ball A with 3 degrees of velocity; for, in the first place let it impinge on the quiescent ball B = 5A; and after this impulse it will recoil with a celerity as 2, but it will transfer into the patient B the celerity 1: In the second place let the ball A impinge with the remaining velocity 2 upon the quiescent ball C = 3A; and again by this second impulse it will lose one degree of velocity; and the patient C will acquire one degree of celerity: In this manner there will remain

Farther considered.

remain to the agent A the celerity 1, after the second congress: And if in fine, it impinge with this celerity on the equal, but quiescent ball D, it will after this third impulse be at rest, and the patient D will obtain that celerity 1, which the agent A had; wherefore, as the ball A has the velocity 3, it may transfer its motion, or rather its whole force into the balls $B = 5A$, $C = 3A$, and $D = A$, so as to give to each the same celerity 1: But the same ball A, with the celerity 1, can so transfer its force only to one ball equal to itself, as to communicate that celerity to the patient, which the agent had before conflict: Wherefore, the force of the ball A with the celerity 3 is to the force of the same ball with the celerity 1, as $5A + 3A + A = 9A$ to A , that is, as 9 to 1, and that is in the duplicate ratio of the celerities.

The same thing will always happen whatever be the ratio of the celerities; and indeed, a curious coincidence discovers itself here between bodies, which are thrown vertically upwards with given velocities, and between bodies which with the same velocities impel other quiescent bodies; for, the altitudes, in each of whose highest points the initial celerity of the ascending body decreases by 1 degree, are altogether in the same ratio of the odd numbers, as the masses of the bodies are; and on which being at rest one degree of celerity is impress'd by successive strokes from a body with so many degrees of initial celerity, as the ascending body had at the beginning of its ascent, which entire celerity of the percutient body is at each stroke diminish'd 1 degree; for instance, the body A, which ascends with the initial celerity 2, at the highest point of the height of 3 foot it will lose 1 degree of celerity, and at the highest point of the height next above the last mention'd it will in like manner lose another degree: for, we know, that a body with its celerity 2 may rise to the height of 4 foot, abstracting now from the resistance of the air and from the other impediments to motion: In like manner the body A with the celerity 2 impinging on the quiescent ball $B = 3A$, by this first stroke it will lose 1 degree of celerity; and if with its remaining celerity 1 it moreover impinge on the quiescent ball $C = A$, and by this second impulse it will lose that velocity: And if the same body A ascend with the initial celerity 3, so as it may reach to the height of 9 foot, at the highest point of the first height of 5 foot, it will lose 1 degree of velocity; at the highest point of the second height next after the first 3 foot, it will still lose 1 degree; and in fine, at the highest point of the third height of 1 foot next after the second, it will lose its third degree of celerity. Now what will be the case with the same body A, if 3 times successively it impinge on the quiescent balls $5A$, $3A$ and A ; on the first with the celerity 3? It will happen, that by the first stroke it loses 1 degree, and if with the remaining celerity 2 it impinge on the ball $3A$, it will lose another degree of velocity; and impinging with that degree of velocity which remains on the
third

third body A, it will lose the third and last degree of celerity. All these things arise of themselves from the doctrine of the motion of heavy bodies, and from the rules of the communication of motion.

12. Nay, these rules of the communication of motion are elegantly deduced from the measure of the living forces of bodies, which we have here undertaken to prove, provided this one principle be admitted, *that the same quantity of forces be preserv'd in the percussion of bodies, as was before conflict.* For, let there be balls whose masses are A and B, their velocities before conflict a and b ; and after conflict x and y ; that principle, therefore, affords the equation $Aaa + Bbb = Axx + Byy$, which I may call the fundamental equation; for, according to our estimation of forces, the forces of the balls A and B before concurrence are as Aaa and Bbb , and their forces after collision Axx and Byy : It, therefore, remains from the fundamental equation to find the values of x and y , but this is very easily done; for, suppose the motions of the balls A and B and their conflicts to be perform'd in a moveable space, as in a ship, which space suppose to move with the indefinitely small velocity dv and tend towards the same part towards which the ball tends; in this manner the balls A and B will before congress be seen to move from an immoveable place (as from the bank of a river, in which the ship or moveable space is carried) with the velocities $a + dv$ and $b + dv$, and after congress with the velocities $x + dv$ and $y + dv$: Wherefore, if instead of the celerities, a, b, x and y of the fundamental equation, the same celerities, increas'd by the adventitious velocity of the deferent space, be substituted, the equality will still remain; namely $Aaa + 2Aadv + Adv^2 + Bbb + 2Bbdv + Bdv^2 = Axx + 2Axdv + Adv^2 + Byy + 2Bydv + Bdv^2$; or cancelling the quantities that mutually destroy each other, $Aaa + Bbb + 2Aadv + 2Bbdv = Axx + Byy + 2Axdv + 2Bydv$: But if from it be taken the fundamental equation $Aaa + Bbb = Axx + Byy$, there will remain the equation $2Aadv + 2Bbdv = 2Axdv + 2Bydv$, which divided by $2dv$ gives $Aa + Bb = Ax + By$; or by transposition $Aa - Ax = By - Bb$. But the fundamental equation supplies this other, $Aaa - Axx = Byy - Bbb$, which farther applied to the preceeding equation gives for the resulting equation $a + x = y + b$: We have, therefore, deduced from the fundamental equation $Aaa + Bbb = Axx + Byy$, these two equations $Aa + Bb = Ax + By$, and $a + x = y + b$: The former of which plainly shows, that the common centre of gravity of two balls A and B moves with equal celerity both before and after conflict; for, $\frac{Aa + Bb}{A + B}$ is the celerity of the centre of gravity before concurrence, and $\frac{Ax + By}{A + B}$ is its celerity after collision; and the other resulting equation shows, that the respective velocity is the same in the acceding balls before impulse, as in the receding balls after impulse.

Now

Now from the equation $a + x = y + b$ is deduced $y = a - b + x$, which value substituted in $Aa + Bb = Ax + By$ gives $Aa + Bb = Ba - Bb + Bx + Ax$, from which is deduced $x = \frac{Aa - Ba + 2Bb}{A + B}$; wherefore, $y = \frac{a - b + x}{A + B} = \frac{2Aa - Ab + Bb}{A + B}$, which celerities were to be deduced from that single principle assum'd and from *Leibnitz's* measure of forces.

The living forces are as the products of the masses into the squares of the velocities.

13. The equations, just now found, and determining the values of x and y , furnish those very rules of motion from percussio, which *Wren*, *Wallis*, *Huygens*, *Mariotte* and others have long ago given for elastic bodies, and establish'd on other principles. What we have, therefore, discover'd in the preceding § may very well serve to prove our thesis, namely *that the living forces of bodies are as the products of the masses into the squares of the velocities*, employing the conclusion as a premiss, and from this afterwards deducing, that $Aaa + Bbb = Axx + Byy$; for, if m denote the vertical height, by which a descending body A with a motion naturally accelerated acquires at its lower extremity the velocity a ; but n denote the height, in whose lower extremity B with a motion in like manner accelerated acquires its celerity b ; in like manner p and q are the heights which the same balls A and B with their initial celerities x and y can pass over with a motion naturally retarded, and m , n , p and q will be proportional to the squares of the celerities aa , bb , xx , and yy , taken in the same order; substituting, therefore, those proportional heights instead of aa , bb , xx , and yy , in the preceding equation, there will result the equation $Am + Bn = Ap + Bq$, or even this equation $\frac{Am + Bn}{A + B} = \frac{Ap + Bq}{A + B}$: But now the fraction to the left denotes the quantity of the descent of the common centre of gravity of the balls A and B , while they run down the heights m and n ; and the fraction to the right denotes the quantity of the ascent of the same common centre of gravity of the balls A and B , while they rise thro' the heights p and q : Wherefore, we must conclude, that the quantity of the descent of the common centre of gravity of the balls A and B before conflict is the same with the quantity of its ascent after conflict, supposing the balls A and B to change their motion, acquir'd in conflict vertically upwards, in the same manner as we suppos'd their velocities before congress to have been acquir'd by an accelerated descent through those heights, which a little before we hinted at: But the quantities of the descent and ascent of the common centre of gravity of the balls A and B , multiplied into the sum of the bodies $A + B$, are the measure of the forces before and after their concurrence: In this manner at least, the illustrious *Huygens* seem'd to have always estimated the forces of several bodies moving together, or acting mutually on each other, as appears from many places of the demonstrations he has given in his posthumous works about the rules of motion from

from percussio, and more clearly still from his theory of the centre of oscillation, which he has exhibited in his *horologium oscillatorium*. But if the sum of the forces of the balls *A* and *B* should be expounded by the product of the descent of their centre of gravity into the sum of their weights, and the sum of the same forces by the product of the ascent of the same centre of gravity of the balls *A* and *B* into the sum of their weights, why may I not, nay, why ought I not to expound their forces apart by *Am* and *Bn* before their congress, and after their congress by *Ap* and *Bq*? But there is no occasion to dwell longer on this argument, as I have others of greater weight; and among these no one seems more evident to me than that, which arises from the consideration of the manner, in which any living force may arise from a dead force.

14. In order to obtain the measure of the living force of any body from its dead force, I proceeded thus: I propos'd to myself the heavy body *C*, falling with a motion naturally accelerated in the vertical line *AH*, so as in *A* to begin its motion from a state of rest: In the beginning of its motion, therefore, I observ'd the body *C* destitute of all living force in *A*, because there it has no motion, and a living force is ascrib'd only to bodies actually in motion; yet it ought to have there a dead force, because it is a heavy body, and has its determinate weight; this dead force I expounded by the right line *Aa*, perpendicular to the other *AH*, but after it was carried to *E*, there it now acquir'd some living force, because there it acquir'd some determinate degree of celerity; but laying aside for a little the consideration of celerity, we are to enquire from what, in what manner and what quantity of living force it has gain'd in *E*, after its descent through the space *AE*. But this living force could from nothing other have acceded to the body *C* than from its dead force; for, we have nothing other to consider here besides the body *C*, its gravity and the space *AE* thro' which it fell; but this space is merely passive, and contributes nothing to the motion; nor can the body *C*, consider'd as extended, and furnish'd with its own determinate mass, produce any motion; and therefore, whatever degree of motion, and force the body *C*, carried to *E*, has, may proceed from the dead force incessantly acting on the body, while it runs over the space *AE*; but in what manner? As the body *C*, when it is in *A*, is urg'd by the dead force *Aa*, in *B* by the dead force *Bb*, in *C* by the dead force *Cc*, in *D* by the dead force *Dd*, and in *E* by the dead force *Ee*, so the same body *C* is urged, in each point of the space run over, by some dead force, equal to *Aa*, if the gravity of bodies be uniform, so that the *locus* of all the dead forces urging the body *C* in the space *AE* be the rectangle *AaeE*; on this account the living force acquir'd in *E* can neither be greater or smaller than the sum of all the dead forces, which may be contain'd in the rectangle *Ae*, which sum is expounded by this very rectangle: Wherefore, the living force, acquir'd in *E* by the descent thro' *AE*, is to the

The measure of the living force of a body obtain'd from its dead force when gravity is uniform.

living force, acquir'd in H by the descent thro' AH , as the rectangle Ae to the rectangle Ab (or because these rectangles have the same common height Aa) as the space AE to the space AH . And these things hold thus, when the gravity in every distance from the earth is the same.

When gravity is different at different distances from the earth. Plate VI. Fig. 2. Demonstration.

But what will be the case if, according to the Moderns, gravity be also different in different distances from the earth? Let us, therefore, suppose the moving body C to be urg'd in the points A, B, D , of the space AH by the dead forces, which the ordinates Aa, Bb, Dd of any curve adb , and passing through the said points, do represent. Now if the descent begins again in A from a state of rest, the living force, which the body descending thro' the space AE has acquir'd in E , is nothing other than the aggregate of all the ordinates Aa, Bb, Dd, Ee , which are contain'd in the area $AaeE$; for, it solely arises from all these mutually succeeding each other; wherefore, the said area $AaeE$ denotes the living force of the body in E , acquir'd by the descent thro' AE ; and the area $AabH$ denotes the living force of the same body in H ; wherefore, the living force in E is to that acquir'd in H , as the area $AaeE$ to the area $AabH$, as the ordinates of these area's expound the weights of the body C at different distances from the earth.

Fig. 2. Demonstration.

And if the body C descend in any curve AEH , and its weights at different distances from the earth be expounded by the ordinates ap, bq, dr , &c. of the curve pqt , the force of the body acquir'd in E by its descent in the arch AE , will be still to the force, acquir'd in H by the descent in the arch AH , as the area $apse$ to the area $aptH$. Let the body come from A to D , and let us consider with how great a dead force it is there urg'd along the tangent DG of the curve in D , when its gravity or weight in D is expounded by the ordinate dr ; for that purpose, let us suppose the arch $AD = s$, the abscissa $ad = x$; the ordinate $dr = g$; the element of the arch, or $Dm = ds$, the element of the abscissa, that is, $nm = dx$; let DF parallel to Ha expound the gravity of the body C in D ; and letting fall from D the perpendicular FG on the tangent to the curve DG , and the dead force DF will be resolv'd into the lateral forces DG and GF ; the latter of which is weaken'd by the curve along which the body proceeds; and therefore, deserves no regard in this place; but the former, namely DG , is the tangential dead force, which has every where its effect, in regard nothing other resists it than the air and the roughness of the curve: But we now lay aside these external impediments to motion, as if they were not. Having now laid down all these things, the similar triangles DFG and Dmn give $DG = \frac{g dx}{ds}$: Let us multiply this into the element of the curve $Dm = ds$, and the product $g dx$ will denote the increment of the living force, which acceded to the body, while it pass'd from one extremity D of the element Dm to its other extremity m , and by summa-

summation, the living force in D or $m =$ the sum of all $g dx$, contain'd in the area $aprd$: Wherefore, the living force in D is equal this area $aprd$, and the living force in $H =$ the area $aptH$. Q. E. D.

In the preceeding article we for facility's sake suppos'd the directions DF of the bodies to be parallel; and the argument is of equal force, if these directions converge to any centre; for, in that case the right lines Aa , Bb , Dd , &c. which are parallel to the horizon, will now run into circular, concentric arches, whose common centre is that point, towards which the directions of the bodies converge.

The argument is of equal force, if the directions converge to any centre.

15. How evident soever the preceeding argument may be, or at least may seem to me; yet we must remove an objection, which may cause a difficulty with some: And it was objected, when first I propos'd this argument in a meeting of the *Academy*, that in like manner the argument proves the living force of any body should be expounded by the product of the time of descent into the dead force of gravity, if gravity be uniform, that is, be every where the same; and in that case, that the living forces of bodies become proportional to the times, in which they acquire these forces, if the bodies are of equal masses; but if of unequal masses, that then the living forces would be in the compound ratio of the times and masses. Let LM , LN , LO , LP and LQ (fig. 4.) be the times in which the spaces AB , AC , AD , AE and AH (fig. 1.) are run over. Now as in each moment of time apart L , M , N , O , &c. the gravity is uniform, so that it may be expounded by the equal, right lines Ll , Mm , Nn , Oo , &c. Why may not with equal truth the sum of all the ordinates Ll , Mm , &c. contain'd in the rectangle $LlmM$, that is, this rectangle itself expound the living force, acquir'd by a body at the end of the time LP , as it was expounded by the rectangle $AEea$ above (fig. 1.) and that because this rectangle is the *locus* and sum of all the Aa , Bb , Cc , &c. contain'd therein; when yet LP (fig. 4.) is the duration of the action of gravity, just as AE (fig. 1.) is the space of descent in the same time? I then made answer, that this latter way of arguing could not take place of the former, in regard that both the time and the celerity are only modal and incompleat *entia*, but that the space run over by the descent is a real *ens*, indicating the number of dead forces collected together, as it were, into one sum, which is the living force: I, moreover, added, that the descending body is in a different state in different points of the time, and that not only the mass of the body C , but likewise its state, or motion, is to be taken into the consideration along with the agent gravity and the small time of action, which I show'd as follows: Let $LO = t$, the time in which the living force V is acquir'd, $OP = dt$, the element of this time, as dV is the element of the acquir'd force, or its increment during the small time dt . As that increment of the living force dV arises from the gravity g acting on the body C , which body may now have the celerity u ,

An objection answered.

Plate VI. Fig. 4

Demonstration.

and the mass M ; and consequently the quantity of motion Mu , a regard must necessarily be had to the quantity of this motion; for, in this state in which it is a moving body, celerity is inseparable from it; the increment, therefore, of the living force will be compounded of these 3, namely g , Mu , and dt ; and therefore, dV will necessarily be equal to $g M u dt$, and not, as is commonly suppos'd, $dV = g M dt$: But now $u dt = ds$, if ds design the element of the space, and $g M$ will denote the gravity of the body C ; if, therefore, we would adapt the formula $dV = g M u dt$ to fig. 1. in which I put $AD = s$, $DE = ds$; and any ordinate $Aa, Bb, \&c. = g M$, it will be $dV = DdeE$; and by summation, $V =$ the rectangle $AaeE$, as we found it § 14. from which it appears, that even the consideration of the time and celerity conduces to the same measure of the living forces found above, providing we rightly take it

Fig. 4.
Demonstration.

16. But if the force of the body C , acquir'd in the time LP , were to be expounded by the rectangle $LPpl$, in which Ll or Mm , &c. would represent the simple gravitation or dead force of the body C , and the rectangle $PQqp$ the force acquir'd in the time PQ , these same rectangles LP and Pq would likewise represent the resistences the body C would have to surmount in its ascent in the times PL and QP , in regard that the ascent of the body is contrary to the continual action of gravity; and should gradually be extinguish'd: Wherefore, if the times LP and PQ were equal, the rectangles $LPpl$ and $PQqp$ will be equal; and consequently, the resistences to be overcome in those times. Let us now see, whether and how far these things agree with the rules of the motion of bodies falling by gravity? Let the body C fall with an accelerated motion begun in A from a state of rest through the space AE (fig. 1.) in the time LP (fig. 4.) and through the space AH in the time LQ ; wherefore, if carried to E it change its motion acquir'd there vertically upwards, it will arrive by its ascent to A , and no higher, on account of the resistence of gravity: As, therefore, this resistence (by hypothesis) is expounded by the rectangle $LPpl$ (fig. 4.) and the resistence of the same body, ascending from H to A , is expounded by the rectangle $QLlq$, supposing LP and PQ equal, the resistences, which the body ascending from H to E , and afterwards from E to A undergoes, must be likewise equal: But if the time of ascent through HA be double of that through EA , HA will be quadruple of EA ; and consequently, HE will be triple of EA : Wherefore, the times of ascent; and consequently, the resistences in the height HE as 3, and in the height EA as 1, would be equal; but this cannot happen, but that gravity does not act uniformly in the whole length of both spaces, but by starts and difformly, which is very absurd and contrary to the receiv'd doctrine about the motion of heavy bodies: For, this doctrine supposes, that a body, in all the points of the space it runs over, or in which it ascends, is heavy; but, to be heavy denotes to be there urg'd by some force, where

where the body is; and consequently, in the common system of gravity, the body is urg'd by gravity in every point of the space it is found in; and that not only in the more common system of uniform gravity, but likewise in all other systems that can be devis'd; for, the universal doctrine of central forces involves a continual action in all the points of the space, without which action this doctrine, now universally approv'd of, cannot consist.

17. It is, therefore, made out, that the living force, acquir'd by the body in *E* (fig. 1 and 2.) by an accelerated descent from *A* to *E*, is to its living force, acquir'd in *H* by the descent from *A* to *H*, as the area *AEea* to the area *AHba*, but not as the area *LPpl* (fig. 4.) to the area *LQql*, supposing that *LP* and *LQ* represent the times of descent in the spaces *AE* and *AH*, and the ordinates *Ll*, *Mm*, &c. represent the gravity of the bodies: From which it spontaneously flows, that the living forces of bodies are necessarily as the products of their masses into the squares of their celerities; which we have chiefly undertaken to deduce from the theory of the motion of heavy bodies, tho' the argument, borrow'd from the collision of bodies (§ 12, 13. *supra*) seems likewise to us very strong and beyond all exception. [To be continued.]

The living forces of bodies as the masses into the squares of the velocity.

Of the family and various properties of Amber. From the Electrologia of Nathan. Sendelius, An. 1728.

Translated from the LATIN:

IT may be doubted to what family or class, whether to that of stones or bitumens, ambers are to be refer'd, authors differ so much about it; for, you may find some among them, who class them with bitumens, and others who rather make them a kind of stone: Each have their own reasons, and as they seem to be of some weight, they have given a handle to others to suspend their judgment: And hence it happen'd, that some of these last authors have refer'd them both to stones and bitumens: Among these was *Magirus*, according to *Hartmann*^a, and *Anselmus de Boot*^b is in some measure charg'd with the same mistake; not to mention many others, especially of the ancient naturalists.

Different opinions about the genus of amber.

Among those, who refer ambers to the genus of stones and particularly to that of gems, the most celebrated is *Hartmann*, who in this had many followers. As to his arguments, that sulphurs and bitumens are soluble in oil, but amber not so, and that this latter exceeds the others in solidity, and that it does not run in a gentle heat, &c. they seem not to be of any great weight; for, as to the first, to wit the solution of ambers in oil, which they have not in common with other bitumens, nothing more can be

Hartmann's arguments for referring ambers to the genus of stones consider'd.

^a Hist. Succin. Pruff. lib. II. cap. 2. § 9. p. m. 12. It. cap. 6. p. 21.

^b Vid. Hist. lapid, & gemmar. lib. I. cap. 1.

be concluded from it than that ambers are of a somewhat firmer texture or cohesion than other bitumens: And who can deny, that ambers may be entirely dissolv'd in oil? as I myself have seen it done by an ordinary heat in rape-seed oil, leaving only behind thin *capsulae* not unlike honey-combs^c. But should I allow, that such amber was more tender or friable, and not sufficiently ripe, yet I have observ'd elsewhere, that more solid ambers have been affected by boiling^d: And such is the penetrating force of lintseed oil, that if it does not consume or entirely dissolve ambers, at least it so destroys them, that they retain nothing of their pristine firmness: Whence amber-turners should beware of the adulteration of rape-seed oil therewith,

The melting of
ambers appears
from experiment.

That the melting of amber cannot be entirely denied appears by experiment. Upon applying different degrees of heat, lesser bits of amber being melted may be made to run into a larger mass; and this is confirm'd to us by the testimonies of *Kerckringius*, *Morboof*, *De Boot* and others, nay of *Hartmann* himself; and tho' the amber loses some of its virtues, yet this operation may be rightly call'd the liquefaction of amber: Not to mention other operations describ'd elsewhere,^e I shall at present only name that easy *encheiresis*, by which a thin piece of amber being heated over the flame of a burning candle becomes so soft, as to be manageable at pleasure; nay, may receive the impression of a seal and that with a small force. As to the solidity of ambers it is not so considerable, as that they may be refer'd to the class or family of stones, as they besides, entirely want many other, either essential or accidental properties of the latter. I own there is a great difference observ'd between *bitumens*: From purer petrol amber and ambergris do concrete; from gross and black petrol, the other more ignoble *bitumens*: But all these must be said to differ rather in degree of mixture than nature, according to *Sturmius*^f; which limitation will also hold of the greater or lesser solidity and hardness of different *bitumens*; and the melting of stones and amber is different, as the former in fluxing yield a glass or *calx*: Whereas on the contrary, the liquefaction of amber does not entirely destroy, but only on account of the flying off of the salts, dissipated by the fire, change their solidity and colour. That other stones burn as well as amber, as of that nature especially is the pyrites (for, I except the agate and pit-coals, which are not referable to stones) the reason is, because this stone has in its concretion a large admixture of sulphur and inflammable matter, which after it is burnt out leaves the stone porous and exhausted of its inflammable matter, and is commonly call'd a pumice-stone: But that the pyrites holds much sulphur appears by striking it with a steel, as also from chemistry, whereby true sulphur may be

^c *Vid.* ACTA GERMANICA, Vol. I. p. 346. An. 1742.

^d L. c. p. 348. 349.

^e L. c. p. 347. seqq. ^f *Vid.* Physic. conciliatrix part. Specialiss. Sect. I. cap. 1. § 3. p. 195.

be obtain'd from it, as *De Boot* remarks and shows the manner of the process. Whence it is, that modern Naturalists do not only conjecture, but solidly demonstrate, that the pumice-stone itself is nothing else but a burnt stone, that has undergone the fire, and is thrown out of the cavities of mount *Ætna* and *Vesuvius*. And if all the *phenomena* of this burning stone be compar'd with amber, they will agree in no respect; as after exhausting and burning out the sulphur of the pyrites it may still remain a stone: But amber on the contrary is entirely consum'd in the burning, leaving behind no trace of its substance, not so much as earthy or stony particles: Amber a bitumica.

Wherefore, it appears, from what has been said, how weak the arguments are for classing amber with stones; and that it is rather a bitumen appears from its origin. *Hartmann* himself allows, that amber is originally soft, and that the experience of people of credit testifies, that it has run in its veins like a limpid oil; and that the workmen in cutting it have sometimes met with something of a liquid or oily bitumen: And as amber is an oil, or liquid bitumen originally, after it is harden'd and has attain'd its due consistence, it must still remain a bitumen and not a stone, the materials of which last are different, as clayey, earthy, saline and rocky. Amber may be dissolv'd, soften'd, bent, melted, set on fire, and in fine, be entirely destroy'd by burning, so that all of it shall evaporate: From all which *phenomena* one must conclude, that a stone is entirely different from a bitumen.

It should seem surprising, what first gave rise or occasion to the classing amber among stones, and especially gems: And I should think, that it proceeded from the inconsiderate appellation of the ancients, whereby amber being abusively, rather than truly and properly, called a gem, because it counterfeited a species of gem, or was held of the same rank and value with gems, the error has been handed down to us. *Pliny*^h seems to confirm this, when he says, that in his time amber was equally valu'd with gems; nay, employ'd in adulterating gemsⁱ; and *Martial* also calls it a gem^k. And no otherwise did the succeeding authors of later times, not so much from any certain and true properties, but rather from some agreement in colour, call amber, a gem, as it seem'd to express by its colour, a chrysolite, carbuncle, hyacinth, topaz and the other differences of gems^l. The occasion of amber being reckon'd among stones.

If I were allow'd to give a definition or description of amber, it would be as follows; namely, *that amber is a bitumen, produced in Prussia, but especially in the bituminous soil of the coast of Sudau and concreted to a proper degree of hardness, emulating a gem in its properties, as in brightness, colour, smell, its force of attracting light bodies or its electricity, and in its medical virtues exceeding all gems and bitumens, nay ambergris itself.* Definition of amber.

Among

^s *Vid. histor. lapid. & gemmar. lib. II. cap. 190. p. m. 520.*

^h *Hist. Nat. 87. cap. 2.*

ⁱ *L. c. cap. 3.* ^k *Lib. IV. epigr. 51. & Lib. VI. epigr. 15.*

^l *Vid. Boetius de Boot,*

lib. II. cap. 1. p. m. 324.

Electricity a principal property.

Among the properties of amber, its electricity is the grand and capital one; and among all electrical bodies this is more peculiar to amber; a property not so well known and free of all doubts, as might, indeed, seem upon a transient view; for, in my opinion, there are difficulties therein, which I now design to note, and if possible, clear up and remove with all imaginable care; as I shall execute this task not so much by bare speculation, as rather by experiments I devis'd for that purpose.

The common theory of electricity.

I presuppose (in order briefly to form a common conception of electricity) the powers of attrition and friction to be otherwise well known in physics; by means of which two solid bodies nimbly mov'd may be brought to heat, as is not only evident in rubbing two pieces of green wood, as also in waggons and other carriages, but especially, which is a more surprising experiment, the same thing is shown in iron, which by the repeated blows of the smith is not only heated, but glows. I moreover presuppose the well known effects of heat and cold, happening either from the rarefaction of the air or its condensation; from which it spontaneously follows, in what manner amber may not only be heated by attrition against a stiff piece of cloth, or other the like body, but likewise in what manner this heat, produced in amber, makes the air in its atmosphere more rare, and afterwards how by the pressure of a heavier and denser air light bodies in its way are at the same time attracted by it, which effect, according to the opinion of the greater number of authors should be rather call'd a pulsion than attraction.^m

Insufficient to account for it, as appears from an experiment of Mr. Boyle's.

This is the genuine and common theory of electricity, to which almost all, at least most naturalists, give in: But that it is insufficient, and that this *phenomenon* of electricity cannot be determin'd in this manner alone, more than one reason seems to persuade; for, supposing this hypothesis to stand good, doubtless, many, nay all heated bodies should have this electric force; and other learned men, upon more accurately examining the matter, were also well appriz'd of this, and hence devis'd various reasons of this *phenomenon*, which we shall note and produce up and down, after first premising the experiments I myself made: In the mean time, however, let this one experiment of Mr. Boyle's suffice for overturning the above-mention'd theory; who, being about to examine, whether the motion of the excited air had any effect on the attractions produced by amber, set about with much apparatus a very difficult experiment by including an animated particle of amber, heated by friction, and for a long time retaining its electric virtue, into an exhausted receiver, in so artful a manner, as to stand near a piece of straw; and in the experiment he observ'd, that by the slightest touch the amber took up the light body, nay and repeating the experiment it rais'd it up without any contact, that is, attracted itⁿ. But I proceed to my own experiments: I

^m *Vid.* Sturm. phys. conciliat. Part. Specialiss. Sect. 1. cap. 1. § 7. p. 198.

ⁿ Boyle's observations on the original of qualities.

I had at hand a vigorous and well polish'd glebe of amber, which I constantly us'd in all my experiments, lest any unlook'd for effect, caus'd by different glebes, should mislead the experimenter; this glebe, when heated by attrition on the palm of my hand, I observ'd readily to attract slips of paper laid on the table: Pouring some drops of oil of almonds on my palm, I again rubb'd the glebe to the same degree of heat, but upon applying the glebe to the said slips, its pristine effect of attraction ceas'd; and again shifting the experiment, and drenching the slips in the oil and approaching the glebe when heated without oil, I observ'd all of them to be attracted.

The Author's experiments.
Experiment I.

I chose another method, calling in to my assistance a coal-fire, because the effect of electricity by any heat, even without attrition, is promoted; and therefore, approaching the glebe heated over the coals to the slips, more than once I observ'd it take them up, namely while the heat lasted, which in this manner is longer conserv'd than by friction alone; and shifting the experiment, because there stood a burning candle hard by, I caus'd heat the glebe over its flame: But my surprise was great, when I observ'd no attraction of the slips thereto: Whereas at the sides of the glebe, where the smoke of the flame had not reach'd, they were taken up. As I was reflecting on this *phenomenon*, I by chance happen'd to wipe the glebe, after which it again readily attracted, tho' it was excited by no new heat than only what it had before.

Experiment II.

It happen'd at the same time, as I was employ'd in making these experiments, that another *phenomenon*, hitherto new to me, offer'd itself, when I caus'd the smoke of an extinguish'd wax-candle, which I chose on account of the less stench, to be attracted by the electrical glebe. This experiment was in some respect known to me, and was first hinted at, out of curiosity, as far as I know, by the ingenious Mr. Boyle^o; but I find it observ'd neither by him nor by any other author, that that smoke is once only attracted, and that after that first attraction the virtue of the amber employ'd is lost; an observation which was, doubtless, omitted by these authors, or not attended to by them, because probably they thought it enough, that they had seen the same effect once, and noted the force of electricity even in this attracted body. To be short, any one will see, that the smoke, once attracted by the electrical glebe, is not farther attracted, but afterwards ascends directly upwards, whether the electrical glebe be applied without intermission to the ascending smoke, or after some time be applied thereto again: But if the smoke, once deriv'd into the glebe of amber, be directly wip'd off, its pristine electrical virtue will in an agreeable manner return, and continue for three or four times, if the glebe while still hot be so often carefully wip'd: I say this must be done carefully, lest instead of wiping you rub too hard, which alone might be a kind of friction:

A new phenomenon observ'd.

Experiment III.

tion: Besides, whoever would accurately make the experiment, must first take care to heat the attracting glebe either over a burning candle, or even burning coals; for, thus the heat is both conserv'd longer in the glebe and the reiteration of the electricity at different intervals is a curious *phenomenon*.

Experiment. IV. That any wet deriv'd to the glebe now excited by friction and dispos'd to attraction, or that the bare breath hinders its attractive force, has, probably, been very well known and experienced by others; and, if I mistake not, ascrib'd to a false cause, as if by this adventitious wet the glebe remitted of its heat. Upon repeating this experiment, indeed, I several times observ'd, that breathing upon it did sometimes no hurt to the attracting glebe, and sometimes really check its attractive force; and in what this difference may consist will be no difficult matter to divine, as it is to be sought for both from the degree of heat in the attracting glebe; namely, as that heat can dissipate or not the vapours of the moist breath, and from a longer or shorter time interpos'd between the act of attraction; for, it happen'd that a glebe, which this moment attracted not, as soon as it receiv'd the breath, would the next succeeding moment successfully attract; namely, as that vapour was discuss'd by the heat of the glebe, both the presence and the going off of the vapour being manifest to the eye; to wit, as the glebe offer'd itself to my view, either overcast with obscurity, or conspicuous in its smoothness and politure.

Conclusions.

What all these experiments may teach seems, probably, evident even without my hinting it; for, they very manifestly confirm, that *effluvia* proceed from the body of the amber: In regard, that even by a transient view we observe, that the pores of the amber, when obstructed by any matter, restrain their electrical force, but that when unlock'd and open'd, they again exert their electricity.

The different
phenomena and
circumstances
of Experiment I.
explained.

Among all the matters that block up the pores of amber, and consequently, restrain its electrical *effluvia*, oil is the grossest: And as the *phenomena* of this experiment were not always the same, it will not be entirely disagreeable nor perhaps useless to relate them here. I said above, that I us'd oil of almonds in making the first experiment, but it was somewhat stale, so as to twinge my ear; and it gave me the hint, whether the same obstruction of the pores of the amber would happen with other more fluid oils. I had at hand (I relate the process in the same order I treated it) neat-foot oil almost a year old, and besides, limpid and clear like thinner oil, by digesting in a window in the sun, and proceeding with this in the same manner, as with that of oil of almonds, the event was not entirely alike, in regard the anointing with this oil upon the amber-glebe or the rubbing it therewith, gave no check at all to the attraction: Surpris'd, therefore, at the event; and now more than ever making the viscosity of the oil of almonds to be in fault, I employ'd other fats and oils in the experiment. The effect of pig's-lard was the same with that of oil of almonds, which

which was not to be wonder'd at, as it was equally stale and viscid: It, therefore, remain'd to apply the subtiler and distill'd oils in the process; yet all of these, tho' very pure and fresh, as oil of mint, marjoram, thyme and lavender, when rubb'd on the amber, depriv'd it of its attraction, without any, nay not the least act of electricity appearing: As, therefore, from these experiments it sufficiently appears, that almost all oils and fats, communicated to amber in rubbing, restrain its electrical force, the reason remains to be discover'd, why neat-foot oil, applied for this purpose, preserves its electricity entire? The solution of which will not at this time give me any anxiety; for, there are many other experiments that might and ought to be made; and there are also various circumstances, which vary this experiment, in regard that that very neat-foot oil above-mention'd, when a year old, equally hinder'd the attracting force of the amber: Whereas on the contrary, the fresher sort, prepar'd for this end, and rubb'd on a glebe, did in no manner restrain its attraction. Whence, whether the greater visciduity and tenaciousness of this oil, or its acrimony, be in fault, which promotes more the obstruction of the pores of amber, I leave to the judgment of others.

That the steam receiv'd from a burning candle and deriv'd into a glebe of amber, but especially, that that fluid aggregate we call smoke, when it is once attracted, does restrain the farther attraction of the amber, is above all others a surprising *phenomenon*; for, the anointing a glebe with oil and the rubbing it therewith, seems evidently to change its former polish'd appearance; so that we may observe by the eye the outlets of the *effluvia* stopp'd and block'd up: But by the steam or smoke of a burning candle, receiv'd only once on the glebe, its appearance is in no manner chang'd; and yet we must necessarily conclude from the effect already mention'd, that the very subtile pores of the amber are block'd up by the matter of the no less subtile smoke.

Why smoke restrains attraction.

We have in like manner remark'd, that wet alone or breathing on the glebe does, by the experiment above alledged, restrain electricity: Wherefore, we may see, that a watery matter, or at least a very subtile watery vapour may obstruct the *effluvia* proceeding from the amber. But it will here seem curious to the experimenter, that the glebe, rubb'd to a heat, and charg'd with the moist, nay the warm breath of the mouth, does not immediately attract, as soon as it is applied more nearly to the light bodies to be attracted, but in some small time after snatches them to itself; the reason of which *phenomenon* is this, namely, that the internal heat of the glebe could not directly at first resist the vapour flowing to it, but in some time after, this vapour being dissipated, the amber exerts its power of attraction: Whence, whoever would set about this experiment with greater accuracy will chuse the winter as the properest season, in regard that then the vaporous humour deriv'd into the hot glebe is evidently condens'd and

The reason of the *phenomenon* in an amber-glebe rubb'd to a heat and wetted.

collected by the external, ambient, cold air, and also soon after dissipated by the heat, the glebe, which was before seen as overcast with a watery vapour, in the mean time acquiring a certain politure and splendor: All which as I revolv'd with myself, there came into my mind a question formerly propos'd in the *Philosophical Transactions*^p; viz. *whether the electrical virtue of amber, and the directive virtue of the magnet are subject to any alteration by an intense cold?* And Kircher, is of opinion, that electricity is diminish'd in thick, foggy weather. The apprehension of these authors, indeed, however groundless, even according to *Hartmann*^a, yet the circumstances just now mentioned and more accurately observ'd in this experiment, according as it is made in winter or summer, might in so far show some different effect; nay I doubt not, but am rather persuaded from experience, that the heat, amber acquires by friction, is sooner lost in winter by means of the cold, as is also the electricity, which I shall show below to be continued in the summer or in a warm stove in various manners.

Electricity how perform'd.

What firm and unshaken doctrine may be drawn from the above-mentioned experiments and their reasons is obvious; namely, that electricity is perform'd by substantial emanations from the attracting body, and in a mechanical manner; for, if it were the effect of a mere quality, and should it be call'd bare pulsion from a heavier to a rarified air, the rubbing of the bodies just now mentioned upon it, by which the heat of the amber glebe is neither lost nor impair'd, would be no impediment at all thereto: Not to mention the testimony of the senses and of the odour only, which amber yields upon friction. From the agreement of this with other reasons is interr'd, that *effluvia* proceed from amber, and that by means thereof its electric virtue is exerted.

The manner how *effluvia* act in attraction, and the diversity of opinions about it.

Tho' we have shown that *effluvia* proceed from electric bodies, it remains to show whether and in what manner they act in attraction, and what that mechanical manner is, in demonstrating which almost all naturalists are greatly employed.

I have cited above the opinion of those who ascribe the pulsion of light bodies towards a heated electric body to a heavier air, and make this the bare cause of attraction; but as this is insufficient, for the reasons there alledged, to account for it, I shall next adduce the opinion of such as hold, that that effect is owing to the air, and yet at the same time admit of *effluvia* proceeding from amber, so that the said attraction is perform'd both by the air and the *effluvia* in conjunction.

But neither thus is every difficulty remov'd, as they also differ in describing that mechanical motion and the manner thereof, by means of which motion the *effluvia*, proceeding from the electric body, do by the pulsion of

of the air return to the same body and carry back with them whatever they meet in their way; for, some imagine a *vortex* in the struggle of the *effluvia* issuing out from the electric body, and returning again thereto by the pressure or resistance of the more remote air: Which opinion seems to give some satisfaction, indeed, in this insensible affection, because the attraction of light bodies, put into commotion at the same time by that *vortex*, may in some measure be more easily conceiv'd.

Others would seek for that mechanical operation in the *effluvia* themselves proceeding from the electric body, and with *Gassendi* conceive them as emitted in various directions, and intersecting each other, so as by this intersection more firmly to lay hold on, and carry back with them the lighter bodies. *Gassendi's* opinion.

Others conceive the *effluvia* more closely adhering to each other, as at the same time in their return to lay hold on the minute bodies they meet with in their way; and such by a great many will be held to be unctuous bodies, which by their unctuousity will insinuate into other bodies and their pores, and being entangled with them, will likewise at the same time carry them back with themselves: And this operation they explain in the manner, 'we see drops of melted fat hanging by a stick; that by a gentle shake, 'one part thereof adhering to the stick, the other may recede some distance from it and immediately return again, and carry along with it 'motes and other minute bodies it meets with'. *Des Cartes's* opinion.

These are the words of the acute *Des Cartes*, who, as he denies not this cause of attraction, just now explain'd, to take place in some bodies, yet not in all, being principally induced by the example of glass, a body equally electrical; in which, indeed, he could not imagine to himself any *effluvia* from its nature as he describ'd it: Assigning, therefore, a different cause of electricity in this body, and which he afterwards applies to many others, he thinks it happens by the intervention of some particles like figur'd *fasciolar*, arising from the subtle matter lodging in the pores and fissures of the glass. That *Des Cartes's* opinion may the more accurately appear from the nature and generation of glass, which he had describ'd in another place, he gathers, that besides the larger intervals every where pervious to the globules of the second element, there are also found many oblong *rimular* between its particles, much more narrow and giving not so free a passage to these globules, as to the matter of the first element alone: Hence he imagines, that this matter of the first element, being accusom'd to put on the figures of all the *meatus* into which it enters, by passing thro' those *rimular*, is form'd into certain thin, broad and oblong *fasciolar*, as it were; which lodge in them as they find not the like *rimular* in the circumjacent air; or at least recede not much from the glass, but with a certain circular motion about its convoluted particles flow from one *rimular*.

† Cart. Princip. Philosoph. Part IX. Art. 183.

‡ L. c. Art. 124.

rimula to another. Now, therefore, as the glass is pretty strongly rubbed, so as to be heated a little, he fancies these *fasciolæ* to be forced out by this motion, and to be dispers'd thro' the adjoining air, and to enter the *meatus's* of the neighbouring bodies; but again return to the glass with minuter bodies carried along by them and entangled therein; because they had not so easy a passage into these foreign *meatus's*.

This opinion
canvass'd.

This thought of *Des Cartes*' is curious; and as I view it more closely, I must repeat the words of *Du Hamel*^u, on *Des Cartes*' ingenious account of the striated particles of the magnet; 'it seems to be equally arbitrary, did it not so well agree to the *phenomena* themselves, that scarce any thing more to the purpose can be devis'd.' Yet there are some things to be oppos'd to this account; and first he seems to have devis'd this hypothesis of electricity for this end, and which he himself owns, because glass, which is otherwise an electrical body, was thought by him to be unfit for emitting *effluvia*. Again he himself is in doubt, whether this his hypothesis shall take place in all electrical bodies or no: Nay, he admits, that the other cause of attraction, just now explained, may take place in some other bodies. In fine, he could learn nothing by his own experience with respect to amber, not having examin'd, as he ingenuously owns, its nature and other properties. Mr. *Boyle* observes, that *Des Cartes* is mistaken in judging glass to be less fit for emitting *effluvia*, as glass mutually rubb'd together is not only observ'd to emit *effluvia*, but those of a disagreeable stench, with whom agree other authors of note and learning^w.

The difficulty of
putting the man-
ner of electricity
beyond all doubt.

From these experiments and reasons some light seems to be thrown on the mechanical manner of electricity; namely, that it happens by an undoubted emission of *effluvia*, either oleous or spirituous. It is difficult, I own, to put it in such a light, as that no doubt shall remain behind, tho' we are previously acquainted with the defects of the opinions of others. Nothing can be discover'd here by the eye, as this affection or quality, we are speaking of, is by naturalists reckon'd among the insensible qualities of bodies, and not acting on our senses, but cognoscible only by reason from its effects.

Mr. Boyle's no-
tion the most sa-
tisfactory.

In the mean time he that is not satisfied with what has been just now said, and who cannot conceive the *nifus* or virtue of the returning *effluvia*, and which has often been a difficulty with myself, such a one, that I may be short, may seek for the emission and retraction of the *effluvia* in their very nature, namely, 'that they are hamous or hook'd, or of any other figure fit for cohesion; and that, therefore, they may be protracted and again contracted like thongs of leather.' These are Mr. *Boyle*'s words and his method of explication*. An opinion, than which I have found none more satisfying and which I would more recommend to the reader. As to the opinion of the moderns it falls in with *Du Hamel's*, who proves, that

^u *Vid. Phys. Part II. Tract. 3. c. 6.*
^x L. c.

^w *Vid. Ephem Germ. Decur. II. An. III. p. 507.*

that electricity is perform'd by tension, and this seems to coincide with *Boyle's* notion.

Now remains to enquire what bodies are attracted by amber, in regard that some maintain, that electricity is perform'd by a certain kind of sympathy, and that, therefore, certain determinate bodies only are attracted, as iron is by the loadstone? But it may be sufficient to say, that all bodies promiscuously are attracted by amber, provided there be a due proportion between the agent and patient, and the bodies so light, that they may be attracted by the weak attractive force of amber: Hence learned men have observ'd different bodies to be attracted, and their experiments I have with pleasure repeated over and over again; for, besides straws and slips of paper (the common subjects of this attraction) any herbs, not only such as are dry, but even the fresh, are attracted, tho' with a more or less strong degree of attraction. The illustrious Mr. *Boyle* has observ'd sand and mineral dusts, provided they are pretty light, to be rais'd thereby; spirit of wine is also attracted, and the smoke of an extinguish'd taper, first observ'd by Mr. *Boyle*, and of which we have treated above^y, is also attracted: Nor is the powder of amber itself, nor its tender *lamelle*, without this attraction. As to bodies drench'd in oil, such are also attracted, provided they are so dispos'd, that a free space be left for the electrical *effluvia* to encompass these bodies, and that these latter do not stick too close to the table on which they are laid. In what manner a piece of amber, hung by a thread, upon applying another piece, approaches thereto, *Kircher* has formerly observ'd; and in what manner a drop of water at rest is almost rais'd into a froth and deriv'd into the body of the amber, *Hartmann* has shown^z. And I myself setting about this last experiment and sprinkling with a fine dust some drops of water on a table, I several times observ'd the water sprinkled with the dust approaching to the amber, and without this dust the approach of the water alone could not, indeed, be so evidently observ'd, especially if I had not a-new heated the amber. The same frequent attraction happen'd with expanded cob-webs, and only once rubbing the amber; nay, after the amber was cool'd, the approach of the cob-web thereto happen'd very frequently, and that in a surprising manner: And the same attraction was repeatedly observ'd in a hair of the head. All which experiments exactly agree with those made by the illustrious Mr. *Boyle*^a, but especially with one, namely, when with a piece of amber, scarce as big as a pea, but highly attractive, he mov'd up and down a pois'd steel needle, for about three minutes, after he had done rubbing the attracting body.

After these experiments I thought proper to enquire, whether living insects are subject to this attraction or no? The first experiment I made was

What bodies are attracted by amber

Whether insects are subject to the attraction of amber

^y Vide ACTA GERMANICA, Vol. I. p. 393. seq. *supra*, An. 1742. ^z Vide Succincto Succ. Pr. Hist. Sect. 4. c. 2. § 3. p. 26. ^a L. c.

was on those moths I often happen to meet with in books. It is an animal of the bigness of the smallest louse, very nimble, and so tender as to be crush'd by the least touch. Upon applying larger pieces of amber, I always observ'd, that the animal would fix and fasten itself, and begin again to run, when either the electrical force was spent, or the amber remov'd. Upon which I began to think with myself, that this animal fasten'd itself with its feet, and stuck its claws in the pores of the paper or table on which it was: But making a wound in its body, so that it could no longer run, nor stand on its feet, and then applying the amber, it was attracted by it. Upon cutting off the head of a common fly, tho' it continu'd alive, yet so as to walk slower, its wings only were attracted by the amber, the animal firmly fastening with its feet on the paper on which I laid it: I, therefore, bethought myself to snip off all its feet with a pair of scissars; upon which the animal was entirely attracted to the amber. I made the same experiments on small beetles, as also on gnats, fleas and lice, and with the same success: And I concluded, that the reason why others miscarried in their experiments was, that they neglected the above precautions.

Some queries
resolv'd.

From what has been said, we may be able to resolve the following queries; why the attracting glebe should be smooth and polish'd? Why impure ambers, and such as are destitute of a proper degree of consistence, cannot attract? As to the first, any one will easily allow, that the *effluvia* cannot penetrate thro' cortical or coated ambers, especially such as have a thick crust; and should they be suppos'd to penetrate that crust, yet it will be granted, that their egress will not be in such quantity, as to produce a due effect: And the same thing holds in the loadstone, which by rust, nay by the very moisture of the air, or by its situation, we observe has even its most vigorous virtue impeded, from the orifices of its *meatus* being block'd up: Nor do crack'd ambers, tho' resplendent and polish'd, always attract well, in regard that in the cracks they have acquir'd unequal sides: Whence on this account neither can an equal attrition be conciliated to the glebe, nor a due egress of the *effluvia* be procur'd, as being hinder'd in their passage by the different angles of the glebe and depriv'd of their united force; nay, neither do glebes that are fil'd attract so well on the same account. It is, therefore, requisite, that the ambers be polish'd, or at least smooth'd; for, I have observ'd, that a smooth glebe has attracted, tho' it has not been polish'd. As to the impurer glebes, or such as are destitute of a good and solid consistence, we are not to wonder at their weak power of attraction, for, ambers of both these kinds are not properly ambers, but rather impurities intermixt with the amber-fluor, or, the recrements of amber; as in many of the pores of the former sort (tho' I should allow that they contain an equal admixture of earthy and amber matter) a foreign matter lodges, and the wide and frothy spaces of the latter are fill'd with air; both which cause that neither a due motion can be excited in friction,

fiction, nor an egress of amber *effluvia* (of which there are but a few in this sort) be effected.

We now proceed to the consideration of the other qualities of amber, Other qualities of amber, and first of its colour. its colour, odour and taste. The colours of amber are various, which may both delight and be of service to workmen in several pieces of workmanship. The most common, omitting their subdivisions, are the waxy or those clear as water, the golden, the milky, the pearly, the squamous or nebulous, the waxy or pale yellow, either more dilute or more obscure, the variegated white, the azure, the green, and the black; besides those differently mix'd and compounded of the simple colours. Yet tho' there is reckon'd so great a number of them, nothing obliges us, that according to the opinion of others we should make those various ambers different species, as they are all of them rather of the same kind, as has been prov'd in another place more at large:^a It will, therefore, remain, that we say they differ in degree, providing in the first place we have some certainty as to the most noble and excellent degree, that upon determining this, we may afterwards rank the more ignoble; and this we have already done^b.

As some ambers have an adventitious admixture of other matter, so they are tinged with different colours; of which kind are the white, the green, the azure, the black and the dingy, or those expressing the colour of roasted coffee-beans. Among those mix'd ambers, the white are the principal, and they are of such a nature, that the more they partake of whiteness, the less they let go their interspers'd opaque matter by any degree of heat whatever, either of nature or art, as I have shewn in another place^c. That, therefore, a foreign and more earthy, and saline, fix'd matter is in too large a proportion added to them in their first mixtion, appears by the boiling alone. The same assertion is evinced by their frequent decrepitations after their accension in a coal-fire, an evident testimony of the more copious presence of salts therein; as also by the stronger and more agreeable odour breathing from them after accension. In fine, the same appears from their distillation, which forces from them a larger portion of that salt and a less portion of oil: Whereas on the contrary, a greater quantity of oil is drawn from the other, either diaphanous or obscure ambers, but a very small quantity of salt: Not to mention their taste, which, according to the greater or lesser degree of whiteness, is found to be acido-saline. Besides, it is well known to the workmen, that the white ambers, on account of their want of sulphureous and oily parts, are not so fit for their works, as they cannot like the others bear being bent and brought to any form: And in fine, upon a general view of the shore, and a particular survey of the veins, we find the shore laid up and down with large beds of nitre and vitriol.

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^a Vid. ACTA GERMANICA, Vol. I. p. 340, seq. An. 1742.

^b Ibid. p. 341, seq.

^c Ibid. p. 349, seq.

Origin of azure,
&c. colours.

As to the cause of the azure-colour, and whether it ought to be ascrib'd to copper or iron, may be disputed. It is certain, indeed, from the principles of Naturalists and Chemists, that copper, dissolv'd in spirit of *Sal ammoniac*, strikes this same azure-colour; but it may be also excepted, that this colour depends on the condition of the concurring spirit, in regard that copper, expos'd to another acid liquor, rather exhibits a green colour. And in fine, that applied in glass-making it sometimes yields a reddish, sometimes a bluish, and sometimes a dark colour. Nor could this be a stronger argument for iron, tho' yet I would rather ascribe to it that azure tincture, as I have often seen azure-glebes, or such as partake of an azure-colour, which had closely lodged in them bits of iron. But because not all amber-glebes including iron have, therefore, this azure colour, hence it will be necessary to presuppose a proper and adequate solvent or *menstruum* of iron. I have sometimes found very beautiful azure glebes, at least one of their sides was still cover'd with a crust somewhat inclining to blackness, and consisting of martial, as I thought, or other metallic layers: But attempting to take off this crust in the lathe, I lost both the glebe and this beautiful colour, which at length I understood had its origin from a certain modification of the light by means of this matter. As to the other glebes, which preserve their blue colour, the matter is different. As to the green colour, it is, indeed, the more rare and was never seen by *Hartmann* himself^d, tho' confirmed to him by credible witnesses: And I myself have seen a glebe with some cast of green; but to speak the truth, that colour was scarcely real, but seem'd to arise from the crust of the glebe, distinguish'd by some obscure greenness between a black, produced by the reflexion of the light.

Black amber the
sacell colour.

As to the other particular colours, as the dingy, or that exhibiting the colour of roasted coffee-beans; and as to the other colours analogous to this, and the different colours peculiar to the impure ambers, as they are call'd, we may judge they owe their origin to the various admixture of some foreign earthy matter or mineral juice: Yet among all other colours the black may be reckon'd the more rare; and whether any such be really found, has hitherto been a question; at least, *Hartmann*, who himself had a considerable collection of ambers, and who besides very carefully examined the different *Museums* of great men, seems to be in doubt, whether black amber is to be found or no; that is, such as is light and solid, and very compact like jet; for, of the other impure, black ambers, which are often call'd by this name, we do not here speak. And *Hartmann* ingeniously owns, that he never saw any such; and upon viewing a glebe that was taken to be black, he found, that it was not black but a yellow mass intermix'd with black. But to put this out of all question, I formerly carried two unexceptionable black glebes to the *Royal Museum*; one of them

^d Hist. Succ. Pr. lib. I. cap. 7. § 6. p. 145.

them was diaphanous, and about a third or fourth part of it black; and that black part was equally smooth and polite as the clearer part, and transmitted no light; the other glebe was all over tinged with black, and equally smooth and polish'd, without admitting any light; so that it was doubted, whether this glebe was amber or no: But upon accension it plainly appear'd to be such, as its grateful odour sufficiently show'd, without that noisome and sulphureous stench of jet, such as it was taken to be.

Whether the colours of ambers may be corrected and chang'd, would be no useless disquisition, both in the art and doctrine of ambers. But this I wave, as I have at large treated in another place^c of the transmutation of ambers into clear and diaphanous; but I shall treat of a more curious change and of an unknown, if not lost, method of tinging ambers, which as I have remark'd in another place^f from *Pliny*, was done among the ancient *Romans*, with the root of *Anchusa*, i. e. a kind of bugloss, and with *conchylium* or the purple juice of a shell-fish: Yet we must observe, that that tincture was only superficial, and in no manner entering deep into the internal substance of the amber. *Hartmann* hints^g, that ambers may be made black by art, at least externally, and that by means of spirit of salt; but as to this encheiresis, if I may speak what I have learn'd from experiment, I could never observe, that amber, either done over or sprinkled with this spirit, became black; and I have sometimes pour'd this spirit on pieces of amber of different colours, as the white, diaphanous and obscure, but I never observ'd any change, much less any blackness in them for many weeks together. It was besides, a matter of curiosity, that a few of those pieces sunk to the bottom, but most of them, especially the white, floated on the spirit. One may probably imagine, that this spirit, applied to ambers, especially when committed to a sand heat, will give them a somewhat darker crust, but whether this is really owing to the spirit, as the fire alone produces this thin black crust, or which inclines to blackness, as I myself have experienced, may be deservedly doubted.

A method of tinging amber among the *Romans*, with observations thereon.

As to the odour of amber, this is none of the least qualities thereof, nay in its usefulness by far the most noted and agreeable, as it recommends itself in refreshing the spirits by diffusing its divine ambrosial odour; nor were the ancient *Romans* wanting in their commendation thereof, as appears from *Martial*^h. But what this odour of amber is, is a question of no less moment? *Hartmann* affirms, that its odour approaches neither to that of myrrhe, camphire nor frankincense, but that it breathes a fragrancy, entirely peculiar and proper to itselfⁱ. Yet we are not to omit, that not all ambers promiscuously after accension yield one and the same odour. The most subtile and grateful odour breathes from the pearly, the milky and the

The odour of ambers what?

E e e 2

other

^c Vide ACTA GERMANICA Vol. I. p. 345. seqq. An. 1742.

^f Ibid. p. 344.

^g Hist. Succ. Prufs. cap VII. § 6. p. 146.

^h Lib. III. epigr. 65. — et Lib. XI.

epigr. 9. — et Lib. V. epigr. 39.

ⁱ Hist. Succ. Prufs. Lib. II. c. 3. § 5.

* *The Sequel of the Measures or Laws of Forces. From the Commentarii Acad. Imper. Petropol. Sept. 1725. p. 27.*

Translated from the LATIN:

The controversy
as to the measure
of forces.

THE same position, *viz.* that the living forces of bodies are as the masses into the squares of the velocities, might have been prov'd by other arguments equally cogent: But as this has been distinctly perform'd by different members of this *Academy*, I shall now wave it, and proceed to the controversial part of the question about the measure of forces. For, the common opinion, which opposes that of *Leibnitz*, has, as it were, by a kind of prescription, found many excellent defendants, whose arguments deserve to be discuss'd.

An objection answered.

In the first place it has been often urg'd, that the idea of the living force of bodies does not imply that of gravity, in regard that every body with some determinate degree of celerity has its own determinate living force, whether that body be understood to have gravity, or to be entirely without it; and that for this reason it is in vain to have recourse to the theory of the motion of heavy bodies for obtaining the measure of their forces. Tho' indeed, we admit of the antecedent, yet the consequence will be nothing the firmer. Suppose that bodies may still be bodies, tho' they are not heavy, and that each of these bodies without gravity have their own degrees of living forces, what shall be the consequence? Indeed, nothing other than this, that these living forces are not the gravity of bodies, nor necessarily flow from gravity, which we no where have said, or ever concluded; but that from the descent of heavy bodies no measure of the living forces can be taken, does by no means follow from the preceeding proposition; for, let there be a body A without gravity, and with the celerity which I shall call *u*; and this body, therefore, will have some living force, which I shall make entirely independent of gravity; let there be another body B equal in mass to the first, but urg'd by gravity; and which falling from the height *a*, may acquire with an accelerated motion a celerity equal to the celerity *u* of the first body A without gravity: Now I ask, whether these equal bodies A and B, and having equal velocities have equal living forces or no? I think there will be no one who can say, that these forces are unequal; for, tho' the first body A is not (by the hypothesis) urg'd by gravity, but the other body B is urg'd thereby; and consequently, this diversity of circumstances seems at first view to induce some inequality of forces on both, yet really it does not; for, as soon as the body B is found in the lowest point of the height *a*, and has there acquir'd the celerity *u*, suppose the action of gravity to cease, the body B will there also be destitute of gravity, and with the acquir'd celerity *u*, it will equably continue its motion, as well as the body A; so that now we have equal bodies A and

* *Vide ACTA GERMANICA. p. 374. seqq. supra.*

and B with equal velocities and without gravity: Whence it is necessary, that their forces be equal. But I grant that the living force of the body A without gravity does not depend on gravity; and yet, therefore, does not the living force of the other body B flow from gravity? Nay, it very much depends thereon, as in the beginning of the descent it had no force, and that which it at length acquir'd, it did so at the end of the space A by the continued action of gravity: But as the forces of the bodies A and B were shown to be equal, cannot and ought not the one to be the measure of the other, tho' the force of the body B flowing from gravity is entirely independent of the force of the body A, which owes not its rise to gravity? From all which it appears, that the above alledged objection can derogate nothing at all from our measure of the living forces.

18. But there were many other objections formerly publish'd by learned men, as by the Abbé Catelan, Dionysius Papin, and others; and all these objections occur as to substance in what not many years ago Dr. Samuel Clarke urg'd against Leibnitz a little after his death, in a treatise publish'd in English and French at London, entitled, *a collection of papers, which pass'd between the late learned Mr. Leibnitz and Dr. Clarke in the years 1715 and 1716*, London 1717, in 8vo. and which Des Maizeaux publish'd again in French with a large preface and other writings, under the title of *Recueil de diverses pieces sur la philosophie, la religion naturelle, l'histoire, les mathématiques, par Mrs. Leibnitz, Clarke, Newton, & autres Auteurs celebres, à Amsterdam in 12mo.* 1720. Now in the note to § 93—95, of the fifth answer to Leibnitz, Dr. Clarke not only endeavours to confute Leibnitz's arguments for our measure of forces, but has also attack'd a certain passage of my *phoronomia* on the same head. But tho' I have in another place examin'd his principal arguments, yet as that is very briefly done in a writing which came into the hands of few, I shall, therefore, here adduce and refute Dr. Clarke's principal objections, and that the more willingly as they afford us greater opportunity of illustrating better the theory of living forces. In the first place the Dr. charges Leibnitz with confusion and contradictions in this argument on forces, that he holds, *that the same quantity of forces is conserv'd in nature*, and yet owns, *that the same quantity of motion does not remain*; where by the term *force* or *active force* he ought necessarily in the present question to understand *the impetus or the impulsive and relative force of moving bodies*. Here the Dr. assumes, that Leibnitz agrees with him, when he supposes, that Leibnitz, speaking of forces in those passages he quoted, understood by that term the impetus or quantity of motion, so that afterwards he might charge him with contradiction and confusion, when Leibnitz differs from him. But the Dr. can adduce no passage, in which Leibnitz by the active force, which he holds to be conserv'd in nature, meant the quantity of motion or the impetus; nay, the contrary appears plainly from himself, because he endeavour'd to show, that the

Objections, especially by Dr. Clarke, answer'd.

the quantity of motion is mutable, but that the quantity of the forces always remains the same. In this matter, therefore, *Leibnitz* has not contradicted himself, but the Dr. hurried by a prejudicate opinion, has begg'd the question. The Dr. afterwards proceeds; *what gave Leibnitz*, says he, *occasion of contradicting himself was, that, thro' an error entirely unworthy of a philosopher, he estimated the impulsive force, as the Dr. speaks, by the quantity of matter and the space which the body runs over in its ascent, laying aside the consideration of the time wherein the ascent is perform'd.* But if what I have demonstrated in §§ 15, 16, 17, be true, namely, that the measures of the forces are the heights to which the bodies can arrive, multiplied into the force of gravity, *Leibnitz* has committed no error, much less such as is unworthy of any philosopher.

19. As to what the Dr. alledges, *that Leibnitz has committed no small error in that he thinks, that this proposition is granted by the Cartesians and other Philosophers and Mathematicians:* That there is as great a force necessary to raise the body *A* of 1 lb. to the height of 4 ells, as to raise the body *B* of 4 lb. to the height of 1 ell, *as the times of these ascents are not equal*, if it is an error, it is only an error of fact, which can derogate nothing from the principal thing: Besides, that above in § 6. I have alledg'd a passage from *Des Cartes* himself, from which it appears, that that illustrious philosopher admitted this controverted proposition without any limitation of the equality of the time; nay, he reckons it erroneous to confound the consideration of the space in the business of the measure of forces with the consideration of the time or celerity; and of this opinion we have given a solid demonstration above in §§ 15, 16. But the demonstration in that place standing good, all that the Dr. further adduces falls to the ground, as it consists of bare assertions without any proof; for, he pretends, *that if any pendulum describes a cycloid, the arch of the cycloid describ'd by the ascent will be proportional to the ascensional force in the lowest point of the cycloid:* And of this proposition he adduces no other proof than this; namely, that the times requisite for the ascent are equal. But how far the Dr. is wide of the truth will appear, after we have consider'd a little more accurately the descent and ascent of a body in the cycloid.

Plate VI. Fig. 3.
The ascent and
descent of a body
in a cycloid.

Let, therefore, the curve *ADH* be a semicycloid; its vertex *H*; and its axis *aH*; its semi-base, therefore, will be *Aa*; let the body *C* begin its descent in the point *A*, and with an accelerated motion run along the concave side of the cycloid, supposing gravity to be every where uniform; in the beginning of its descent, therefore, the body will be urg'd along the direction of the tangent to the cycloid in the point *A* with the force expounded by the arch *AH*, thus *Newton* first, and afterwards several other authors have demonstrated; but which is well to be noted, this tangential force is not a living, but only a dead force; for, it is deriv'd from the force of gravity, which is a dead force only. The body afterwards carried from *A* to

A to *B* will in this point be also urg'd in the direction of the tangent with the dead force, expounded by the arch of the cycloid *BH*, and so in every other point of the cycloid with a certain dead force, expounded by the arch of the cycloid between that point and the vertex *H*: Moreover, let there be suppos'd erected in the points *A*, *B*, *D*, &c. and in all the intermediate points, perpendiculars to the plane of the cycloid and respectively equal to the arches *AH*, *BH*, *DH*, &c. there will thence arise a cylindrical surface, whose base is the cycloid *ADH*; and I contend, that this whole surface and its parts are the measures of the forces, acquir'd by the descent of a body down *AH*, or the parts of this arch; for, the force, acquir'd in the lowest point of the cycloid *H*, is the complex of all the dead forces, whereby the body is urg'd in the points *A*, *B*, *D*, *H*, and all the intermediate ones; for, whatever force it has in *H* it owes it to all these dead forces continually acting on the body; and therefore, the force acquir'd in *H* can neither be greater nor smaller than that complex of dead forces, from which it resulted, and that cylindrical area comprehends all the lines representing all the dead forces. For instance, if $AL = AH$, $BM = BH$, $DN = DH$, and so on in respect of all the other arches of the cycloid, and these *AL*, *BM*, *DN* be perpendicular to the plane of the cycloid, the cylindrical surface *ALMH* comprehends all the *AL*, *BM*, *DN*, &c. which expound the dead forces whereby the descending body is urg'd in *A*, *B*, *D*, &c. The said cylindrical surface *HAL* does, therefore, expound the force acquir'd in *H* by the descent thro' the arch *AH*: For a like reason the surfaces *LABM*, *LADN* will expound the forces, acquir'd by the body in *B* and *D*, the beginning of the descent from a state of rest being in *A*.

Plate VI. Fig. 5.

It remains to examine the quantity of the surface *ALH* and its parts. Let the arch *DH* be equal $DN = s$, and its element $= ds$; wherefore, the element of the surface *HDN*, which arises from multiplying the ordinate $DN = s$ into the element of the arch *HD*, becomes $= sds$: Wherefore, by integration the area itself *HDN* becomes equal $\frac{1}{2} s.s = \frac{1}{2}$ the square of the arch *DH*: And therefore, the whole area *HAL* $= \frac{1}{2}$ the square of *AH*, and the areas *ABML*, *ADNL* are equal $\frac{1}{2} AH^2 - \frac{1}{2} BH^2$, and $\frac{1}{2} AH^2 - \frac{1}{2} DH^2$. Now supposing these things it follows, that the force acquir'd in *H* by the descent down the arch *AH*, which is represented by the area *HAL*, is proportional not to the arch itself *AH*, as Dr. Clarke imagines, but to $\frac{1}{2}$ the square of that arch *AH*; and so great also, at first is the force of the ascending body in the cycloid from *H* to *A*; but if the descent begin from a state of rest in the point *D*, the force acquir'd in the lowest point *H* will be proportional not to the arch *DH*, but to $\frac{1}{2}$ its square, and to this is equal the force of the body ascending in the arch *HD*.

When the Dr. farther says, *that if two equal bodies at different distances from the axis of any balance gravitate on its arms, the forces of these bodies will be as the arches they describe, because they run them over in equal times*, he does not touch on the true reason, why these forces are as the arches, describ'd; for, these forces are as the arches, not because the arches are describ'd in equal times, but because the action of gravity is continual, and because in all the points of the arches these bodies are urg'd by a certain equal dead force.

But the Dr. proceeds, *if two equal balls be impell'd with unequal forces on a horizontal plane, in equal times they will describe spaces proportional to the impelling forces; or if unequal balls be impell'd by equal forces, in equal times, they will describe spaces reciprocally proportional to their masses*. Both these propositions are false; for, first let there be two equal quiescent balls A , A ; the former of which suppose to be impell'd by the ball B with the celerity b ; but the other by the ball C with the celerity c ; by the rules of the communication of motion, the former ball will acquire the celerity $\frac{2 B b}{B + A}$; and the other ball A will receive from the impelling ball C the celerity $\frac{2 C c}{A + C}$: The space, therefore, to be describ'd by the first ball A is to that to be run over by the other in an equal time, as the former fraction $\frac{2 B b}{A + B}$ to the latter $\frac{2 C c}{A + C}$; but these fractions are not as the impelling forces, which according to our author's hypothesis are as $B b$ and $C c$: Wherefore, his first proposition is false.

Let us now see, whether his second has any place or no? Now let the two unequal quiescent balls A and B be both impell'd by the equal balls C , C with equal celerity a ; by the same rules of the communication of motion the ball A will receive the celerity $\frac{2 C a}{A + C}$, and the ball B the celerity $\frac{2 C a}{B + C}$; and these celerities are as the spaces, which both the balls will after impulse describe in an equal time; but these spaces are not proportional to the masses of the balls A and B , as the Dr. affirms: Wherefore, his second proposition is also false. And, therefore, all the consequences, which he draws from his premisses against *Leibnitz* fall to the ground; and I may venture to say, that in almost all that follows, he always begs the question, because he almost every where supposes, that the forces of bodies are as the quantities of motion, which notwithstanding is deny'd by *Leibnitz*, and is the point in question; he ought, therefore, to have advanc'd some proper demonstration of his proposition, before

before he should object to *Leibnitz* and others of his opinion, I know not what contradictions and absurdities. He will, probably, seem to have given a demonstration of his proposition in the following period, which runs thus ; ‘ *Galilæo* in the supposition of uniform gravity has demonstrated the motion of projects in non-resisting medium’s; and all mathematicians, not excepting *Leibnitz* himself, assent to his propositions : But now if the time, wherein a body runs over its space, be understood to be divided into equal parts; as gravity is uniform, and therefore, in equal parts of time acts equally, it must by its action impress upon and impart to a body equal forces, velocities and motions in equal times’. But this very consequence, in so far as it regards the forces, is false, as it is true, that in equal times equal celerities and equal motions are generated by the continual action of uniform gravity; for, to the producing increments of velocity, gravity equally acts on bodies in motion, as on those at rest, so that in equal times equal increments of velocity may be added to the body, whether it be in motion or at rest; but the case is different as to the increments of the forces; for, in computing these, the present celerity is to be taken into the account, nor can it be said, that these increments of the forces are simply as the increments of the time, but rather in the compound ratio of the celerities, already acquir’d, and of the increments of the time; that is, as the increments of the spaces, namely if the masses of the bodies be equal, which we have prov’d at large above. After that the Dr. has deduced various other consequences from that primary one, which I have just now refuted, he at last falls upon myself, as follows; ‘ but *Hermann* has fallen in with *Leibnitz* against those, who hold, that the forces acquir’d by falling bodies are proportional to the times in which these descents are perform’d, or to the acquir’d velocities: *Hermann*, I say, asserts, that it is founded on a false supposition, namely that bodies thrown upwards do in equal times receive an equal number of impulses from gravity, which is the same thing, as if *Hermann* had said, that gravity is not uniform, which is entirely to overturn *Galilæo*’s theory, in which all geometricians agree. I imagine *Hermann* supposes, that the swifter the ascensional motion is, the greater number of impulses the bodies receive, because they meet with (*imaginary*) particles, which produce gravity; and thus the weight of bodies will be greater when they ascend, and lesser when they descend’. From these things the reader may see how sagacious the Dr. is in deducing consequences, and exploring the meaning of his adversaries. I said in my *Phoronomia*, that their opinion is founded on a false hypothesis, who measure the forces of ascending bodies by the times of ascent, as they tacitly suppose that bodies, in equal times receive an equal number of impulses: And as in the cited place I especially disputed against *Papin*, I made use of the term *impulses*, as he himself first employ’d it, to design the resistences.

resistences an ascending body has to overcome, and from this the Dr. directly concludes, that it is the same thing, as if I had said, that gravity is not uniform; and consequently, that that was entirely overturning *Galilæo's* theory. But if you look for the connection between this proposition, *heavy bodies thrown vertically upwards not in equal times, but ascending thro' equal heights, suffer equal resistences from gravity*, and this other, *that gravity is not uniform*: This connection the Dr. has no where shown, and perhaps never can. But now he acts the critic, and explores my secret meaning not express'd in words; for, he imagines that, according to my opinion, ascending bodies receive the greater number of impulses from gravity, the swifter the ascensional motion is, because they meet with particles, which produce gravity, and which he calls *imaginary*, doubtless, for this reason, because gravity, according to him, is an *occult quality*. But to be serious, and to give the Dr. a direct answer, he may see these two propositions geometrically demonstrated in several passages of the present dissertation. 1. From this, *viz.* that gravity is uniform, the measures of the forces of bodies are in the compound ratio of the masses and heights, which projects with those initial velocities, which the bodies have, may run over. 2. But if these forces were in the compound ratio of the masses and of the times of ascent, gravity would not act uniformly, but by starts: And therefore, according to the Dr's hypothesis, gravity is not uniform; and consequently, *Galilæo's* theory is destroy'd, which in our system remains entire.

But we must examine a weighty argument the Dr. still urges against us: 'If the force, *says he*, which a body by falling acquires, is as the space describ'd, let the time be divided into equal parts, and if in the first portion of time it acquire one portion of force, in the two first portions of time it will acquire four portions of force, and in the three first portions of time, 9 portions of force, and so on: Wherefore, in the second part of time it will acquire three parts of force; in the third part of time five parts of force, &c.' So far is very well. But the consequences he draws from hence are but weak: 'If, therefore, *proceeds he*, the action of gravity producing these forces be suppos'd to be of one degree in the middle of the first part of the time, in the middle of the second, third, fourth, &c. parts of the time it will have 3, 5, 7, &c. degrees'. But this is very false. For, the action of gravity in the middle of each time is the same, as in its beginning and end. We may judge of the strength of this argument from this, namely, that in like manner it may be prov'd, that because the spaces, describ'd in equal times afterwards, are as the odd numbers 1, 3, 5, &c. that gravity also, which causes that these spaces are describ'd by the bodies, is as the same odd numbers; for, if we suppose that the action of gravity, which causes these spaces to be run over in the middle of the first time is of one degree, the action of gravity in the middle of

of the 2d, 3d, and 4th part of the time will have 3, 5, 7, &c. degrees: Wherefore, from this argument of the Dr's we have prov'd, that because gravity is uniform, it is not uniform. But the Dr. seems to have argu'd thus, that he might conclude in these words, *that is, the action of gravity will be proportional to the time and to the velocity acquir'd.* But I would fain know in the middle of what time the action of gravity is proportional to the product of the time into the celerity? in regard this is not known from the premisses; for, in these he recited the order of the equal times, in the middle of which the action of gravity follows the series of the odd numbers: But one must be very quick-sighted, who can hence see, that the action of gravity is proportional to the product of the time into the celerity; and in fine, that at the beginning of the time gravity is none. Had the Dr. said, that in the beginning of the first time the living force of the body is nothing, he had said nothing wide of the truth, but that there should be no gravity, will never be fairly deduced from our system.

I at length come to the Dr's *Achillean* argument, which, according to him, seems entirely to overturn our estimation of the forces; for, he puts a period to this dispute in the following words; 'that the present controversy may be demonstratively decided, let two steel-balls hang from two threads of equal length in such manner, that when the balls remain suspended and touch each other, the threads may be parallel; let either of these balls be always the same, and let it be drawn from the other to the same distance in all the experiments; let the other ball be of any bigness at pleasure, and let it be drawn off to the opposite side to a distance reciprocally proportional to its weight: Let both these balls fall down in the same moment of time, in such sort that in the lowest point of descent, at which they remain'd suspended before they were separated from each other, they may mutually touch. The first ball will refile always in the same manner, that is, to the same height: Wherefore, the force of the one is always the same, as often as its celerity is reciprocally proportional to its weight; and consequently, the weight remaining the same, its force will be proportional to the velocity. Q. E. D.

The better to take the force of this pretended demonstration, I shall explain the whole matter by Fig. 6. Let the equal threads DF , EG be suspended at D and E , at their lowest extremity fasten steel-balls, namely to the thread DF the ball A , and to the thread EG the ball B ; the distance of the points of suspension D , E , must be equal the sum of the semidiameters of the balls A and B ; or if instead of the ball B , another bigger or smaller be employ'd, and which I shall call C , that the distance DE may be equal to the sum of the semi-diameters of this ball and the ball A , for this purpose, that as often as the threads DF and EG are in a vertical position, the balls A and B or the balls A and C may mutually touch. Suppose the horizontal line MN to pass thro' the centres of the balls,

Fig. 6. Plate VI

balls, and that the points, F, G , design these centres; from the centre D with the radius DF let the arch FO be describ'd; and from the centre E with the radius EG the arch GP ; let the arch FH be to Gi , as the ball B to the ball A ; and let the ball A be brought from F to H ; and the ball B from G to i ; and let both begin to descend together from H and i and in the same time they will arrive thro' the arches HF and iG in F and G , and there they will mutually impinge, so that both may recede in the same arch in which they fell, to wit, the ball A will after impulse recede from F to H ; and the ball B from G to i , laying aside the consideration of the resistance of the air. After this experiment let the ball B be taken off from G and there let another ball C be fasten'd in such manner, that the distance DE may now be equal to the sum of their semi-diameters; and let C be to E as the greater arch GK to the smaller Gi . Now let us suppose the balls A and C to begin their descent together at H and K ; and again in an equal time with an accelerated motion they will describe the arches HF and KG ; and in F and G they will mutually impinge with the celerities expounded by the arches HF and KG ; but again after impulse the ball A will refile from F to H , and the ball C from G to K ; and therefore the ball A in both experiments refles to the same height HL : Whence the Dr. concludes, that the force of one of the balls, either B or C , is likewise always the same, as often as the final celerity of the ball B is to the final celerity of the ball C , as this latter ball to the former.

But I may say, that I could have no fitter medium to confute the Dr. measure of forces than this very experiment he adduces; for, first his conclusion, namely, that the forces of the balls B and C are equal, can be fetch'd from nothing other than from this supposition, that both the force of the ball B and that of the ball C is equal to the force of the ball A refiling always in the same manner. But this supposition is a mere begging of the question; but that I may not seem to have said this without proof, I shall in the second place show, that supposing all those things which are suppos'd in the experiment, the force of the swifter ball C is greater than that of the other B ; but this will be demonstratively prov'd, after I shall have shown, that the common centre of gravity of the balls A and C ascending in the arches FH and GK , rises higher than the common centre of gravity of the balls A and B ascending in the arches FH and Gi ; for, so, the forces of the balls A and C effect something more than the force of the balls A and B , that is, the force of the ball A + the force of the ball C is greater than the force of the ball A + the force of the ball B consequently, as (by the hypothesis) the force of the ball A is in both cases the same, there remains the force of the swifter ball C greater than the force of the slower ball B ; and therefore, it only remains to prove, that the common centre of gravity of the balls A and C ascends higher than the common centre of gravity of the balls A and B . On the horizontal line

NL let fall from the extremities *H*, *i*, *K*, of the arches the perpendiculars *HL*, *iM* and *KN*; and let *HL* be equal *a*; *iM*=*b*; *KN*=*c*, as also the arches *FH*=*l*; *Gi*=*m* and *GK*=*n*: And in fine, the diameter of these arches or 2 *DF* or 2 *EG*=*d*; supposing these things (by the hypothesis) the arch *GK* (*n*) is greater than the arch *Gi* (*m*) and therefore, *ln* is greater than *lm*, that is, the fraction $\frac{lln + lnn}{dl + dn}$ is greater than the fraction

$\frac{llm + lmm}{dl + dm}$; but as the arches *FH*, *Gi*, *GK* are very small, they will coincide with their chords; and therefore, *ll*=*ad*; *mm*=*bd*; and *nn*=

cd; which substituted in the preceeding fractions, it will be $\frac{an + cl}{l + n}$

greater than $\frac{am + bl}{l + m}$, or which comes to the same thing $\frac{anA + clA}{lA + nA}$

greater than $\frac{amA + blA}{lA + mA}$. But the construction gives the equations *lA*=

mB, and *lA*=*nC*: And therefore, in the first fraction substituting *nC* for *lA*, and *mB* for *lA* in the second, it will be $\frac{Ana + Ccn}{nA + nC}$ or $\frac{Aa + Cc}{A + C}$

greater than $\frac{Aam + Bbm}{Am + Bm}$, or $\frac{Aa + Bb}{A + B}$. But from Centrobarics it ap-

pears, that the former fraction $\frac{Aa + Cc}{A + C}$ denotes the distance of the com-

mon centre of gravity of the balls *A* and *C*, when in *A* and *K*, from the horizontal line *LN*; and the other fraction $\frac{Aa + Bb}{A + B}$, the distance of the

common centre of gravity of the balls *A* and *B* when in *H* and *i*: Wherefore, the centre of gravity of the balls *A* and *C* rises higher than the centre of gravity of the balls *A* and *B*; and therefore, the force of the ball *C* is greater than that of the ball *B*. Q. E. D.

Let it cause no difficulty to any one, that in the preceeding demonstration I have suppos'd the arches *FH*, *Gi*, *GK* to be indefinitely small, so that they may be taken for their chords; for, the demonstration even holds, when these arches are of a finite magnitude; but then the balls *A*, *B*, *C*, should be reciprocally proportional, not to the arches *FH*, *Gi*, *GK*, but to the chords of these arches.

A juridico-Mathematical Meditation on Rebate at simple Interest.
By G. G. L. From the *Acta Eruditorum* Lips. An. 1683. p. 425.

Translated from the LATIN.

Discount what.

REBATE or discount is the difference between money due against a certain day, and its present worth; or how much less it is just, one should pay, who, not becoming indebted till some years after, makes present payment; the quantity thereof, which among lawyers is for the most part not sufficiently, and among others not rightly enough explain'd, may be determined by an accurate *calculus*, assuming the two following suppositions from law.

Supposition 1st.

1. The first supposition is, that he, from whom money is demanded before it becomes due, may in his turn require, that upon that score each ensuing year of mean time a legal interest be paid him; as for instance, after 10 years you shall owe me 100 (on which, however, you owe no interest, otherwise you would now owe the principal) I who probably am to carry on some profitable business, but which requires ready money, ask and obtain of you to pay me now down; you in your turn may require, that upon that account I pay you 5 at the end of each year of the ten, and it matters not whether the money, which is paid before the time be principal or interest.

Supposition II.

2. The second supposition is taken from a well known principle in law, to wit, that compensation is a kind of payment; and he, who allows a certain sum to be deducted from the money he receives, is reckon'd to have paid that very sum at that very time.

Postulate.

3. To these things I add this postulate, that a creditor and debtor against a certain day to come, may presently enter into an agreement about money not yet due, so that the whole business may be decided between themselves, and that without detriment to either party; the creditor, therefore, who now receives before hand 100 which are not due till 10 years after, ought on that account each year of the succeeding 10 to pay 5; and in order to free himself and the debtor from that trouble, and to conclude the whole business, he may allow that at present something be deducted from the 100, on the score of future interest, and that indeed not quite 50 or 10 times 5; for, they do not yet fall due, or their day is not yet come, but somewhat less. He will therefore, receive less than a 100, and the deduction he allows is the rebate itself, which is now to be determined.

Conclusion I.

4. From these things we shall now draw the first conclusion; to wit, if the legal interest be the 20th part of the principal, the present worth of unity due a year after will be $\frac{1}{1} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000} - \frac{1}{3200000}$, &c. in infinitum, or more generally, assuming, instead of 20, any number

v to

to express the rate of interest, it will be $\frac{1}{v} - \frac{1}{v^2} + \frac{1}{v^2} - \frac{1}{v^3} + \frac{1}{v^3} - \frac{1}{v^4} + \frac{1}{v^4} - \frac{1}{v^5}$, &c.

Immediately at the end of the year you shall owe me unit or 1, as for instance, 1 pound, 10 or 100 pounds, &c. If you now pay me down this unity or principal, on account thereof I shall at the end of the year owe you interest, to wit, the 20th part of unity or $\frac{1}{20}$ (by *suppos. art. 1.*) but because we agreed to decide the business immediately between ourselves (by *Postulat. art. 3.*) you, therefore, in your turn demand, that I now pay you this sum of $\frac{1}{20}$ by advance: But this payment may be made by compensation, if I allow as much to be deducted from the sum I was to have of you (by *suppos. art. 2.*) I, therefore, receive $\frac{1}{v} - \frac{1}{20}$. But as thus you also have now receiv'd the sum $\frac{1}{20}$ not due till a year after; on that score you shall at the year's end owe me interest (*art. 1.*) namely, the 20th part of $\frac{1}{20}$, that is $\frac{1}{400}$; and as we are immediately to decide the matter among ourselves (*art. 3.*) besides the preceeding sum, which was $\frac{1}{v} - \frac{1}{20}$, you shall give it me directly; you will, therefore, now give me $\frac{1}{v} - \frac{1}{20} + \frac{1}{400}$; but thus you have now also given me the sum $\frac{1}{400}$ not due till a year after; on that account, therefore, I in my turn shall at the year's end owe you interest (*art. 1.*) namely, the 20th part of $\frac{1}{400}$, that is, $\frac{1}{8000}$; and as we are immediately to decide the matter (*art. 3.*) I shall now directly pay you this interest before-hand, without again any detriment to the consideration of anticipation: but I may pay it by compensation (*art. 2.*) or I shall allow $\frac{1}{8000}$ to be directly deducted from the preceeding sum, which you should pay me, and which was $\frac{1}{v} - \frac{1}{20} + \frac{1}{400}$; you shall, therefore, pay me $\frac{1}{v} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000}$: And thus supposing the *calculus* to be continu'd in *infinitum*, and always by anticipation (that the matter may be directly decided) and neglecting no rebate (that neither of the parties be loser) it is evident that you ought to pay me now the sum of the above infinite series, whose terms are in a subvigecuple geometrical progression; for, the following term, is always the 20th part of the immediately preceeding one; and the signs + and - are alternate.

5. The fraction $\frac{v}{v+1}$ is = the whole infinite series $\frac{1}{1} - \frac{1}{v} + \frac{1}{v^2} - \frac{1}{v^3} + \frac{1}{v^4} - \frac{1}{v^5}$, &c. Lemma.

Supposing v to be 20, we are to show that the fraction $\frac{20}{21}$ is the same with the infinite series $\frac{1}{1} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000} - \frac{1}{3200000}$, &c. Demonstration and explication. namely, the fraction $\frac{20}{21}$ multiplied by 21 gives 20, as is plain; and that infinite series multiplied by 21 gives also 20, as shall be shown anon. Now such quantities, whose equimultiples are equal, are themselves equal; the fraction and series, therefore, are equal: It remains only that we show, that the series, multiplied by 21 or 20 + 1, gives 20; the operation will stand thus.

$+ 1 - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000} - \frac{1}{3200000}, \&c.$ multiplied

By 20 $\frac{20}{20} - \frac{20}{400} + \frac{20}{8000} - \frac{20}{160000} + \frac{20}{3200000}, \&c.$

It will be $\odot$, $20 - 1 + \frac{1}{20} - \frac{1}{400} + \frac{1}{8000} - \frac{1}{160000}, \&c.$

Let $+ 1 - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000}, \&c.$ be multiplied

by 1 $\frac{1}{20} - \frac{1}{400} + \frac{1}{8000} - \frac{1}{160000}, \&c.$

It will be D , $+ 1 - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000}, \&c.$

Therefore $\odot + \text{D} = 20$.

The second conclusion.

6. The present worth of 1, or of the principal due a year after, is $\frac{v}{v+1}$,

supposing v to be a number expressing the rate of interest, or if v be 20, that is, if the interest be the 20th part of the principal, it will be $\frac{20}{21}$ of the principal, or $\frac{100}{105}$; for, that present worth is $1 - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000}, \&c.$ (*art. 4.*) that is (*art. 5.*) $\frac{20}{21}$ or $\frac{100}{105}$, which was to be prov'd: But if the interest was 6 in 100, then the number would be worth $\frac{100}{106}$, or $\frac{50}{53}$, and the present value of the principal would be $\frac{100}{106}$, or $\frac{50}{53}$ of the principal. The same conclusion may still be found and demonstrated in another manner, without an infinite series, as follows; at the year's end you shall owe me the sum of S , it is requir'd how much is justly to be paid me now, that the matter may come to the same thing. Suppose you ought to pay me now Y ; the sum Y , therefore, should be such, as at the year's end the interest with the principal may be equal to what you owe me; for, you have given me Y not now due; I, therefore, owe you Y , and at the year's end I shall owe you Y together with the 20th part of Y , or $Y + \frac{1}{20} Y$, which if equal to S , the sum due me at the year's end, by making a compensation, the debt will then in equity be mutually cancelled (*art. 2.*) and the business may be understood to be determined between us at first (according to *art. 3.*). Because, therefore, $Y + \frac{1}{20} Y = S$, it will be $Y =$

$\frac{S}{1 + \frac{1}{20}}$, or $Y = \frac{20}{21}$ of S , as above; for, if you pay me now $\frac{20}{21}$ not due,

at the year's end I shall owe the interest of $\frac{1}{21}$; therefore, at the year's end I shall owe you in the whole $\frac{20}{21} + \frac{1}{21}$, or $\frac{21}{21}$, or 1: But at the year's end you shall also owe me 1, to wit, unity or the principal; by making a compensation, therefore, it appears, if for 1 then to be due, you now pay $\frac{20}{21}$, neither will owe the other any thing. But tho' this way be in this case more easy than the preceeding, yet I take the preceeding method to be of great moment, because it gives us an instance of a remarkable analysis different from algebra in this; namely, that algebra, as appears in the latter way, assumes an unknown quantity as known, and thence by regression and an equation with known quantities it seeks its value: But the former analysis, proceeding by mere known quantities, obtains directly the unknown value, a thing of great use, when it is impossible to obtain the rational value of the unknown quantity by algebra; for, then notwithstanding, it may be obtain'd this way by an infinite series.

7. Sup-

7. Supposing the same things, *the present worth of unity, or the principal* The third conclusion.

due after two years is $\frac{1}{1} - \frac{2}{v} + \frac{3}{v^2} - \frac{4}{v^3} + \frac{5}{v^4} - \frac{6}{v^5}, \&c.$

Two years hence you shall owe me 1, which if you now pay me before-hand, on the score of interest I shall owe you after a year $\frac{1}{2v}$; after two years, again $\frac{1}{2v}$; in the whole $\frac{2}{2v}$, which if you immediately abate (*art. 5.*) you will only give me $1 - \frac{1}{2v}$: But because in this manner you have also the former $\frac{1}{2v}$ one year before-hand, to wit, the first; and the latter $\frac{1}{2v}$ two years, to wit, the first and second; you shall, therefore, owe me interest after the first year both for the former and latter $\frac{1}{2v}$, received before-hand the first year, namely twice $\frac{1}{4v^2}$, or $\frac{2}{4v^2}$; and after the second year, on account of the latter $\frac{1}{2v}$, received the second year by advance, you shall owe me $\frac{1}{4v^2}$, the sum, therefore, $\frac{3}{4v^2}$, which if again you pay me by advance, you shall give me $\frac{1}{1} - \frac{2}{2v} + \frac{3}{4v^2}$, but thus now, I have again the former $\frac{2}{4v^2}$ before-hand the first year; but the latter $\frac{1}{4v^2}$ the first and second years: Whence I shall owe you interest, which after the first year will be $\frac{2}{8v^3}$ of the former $\frac{2}{4v^2}$, and $\frac{1}{8v^3}$ of the latter $\frac{1}{4v^2}$, the sum $\frac{3}{8v^3}$; but the second year the interest will be $\frac{1}{8v^3}$ of the latter $\frac{1}{4v^2}$; and the sum of the interests of the first and second years $\frac{4}{8v^3}$, which if again I allow to be abated by discount, you shall only give me $1 - \frac{2}{2v} + \frac{3}{4v^2} - \frac{4}{8v^3}$; but thus now you have again received the former $\frac{3}{8v^3}$ before-hand the first year, the latter $\frac{1}{8v^3}$ the first and second years: Whence you will owe me interest, which the first year is $\frac{3}{16v^4}$ of the former $\frac{3}{8v^3}$; and $\frac{1}{16v^4}$ of the latter $\frac{1}{8v^3}$, the sum $\frac{4}{16v^4}$; the second year is again $\frac{1}{16v^4}$ of the latter $\frac{1}{8v^3}$; and the sum of the interests of the first and second years $\frac{5}{16v^4}$, which if you pay me directly by anticipation (regarding in the continuation of the *calculus* the rebate) you shall give me $1 - \frac{2}{2v} + \frac{3}{4v^2} - \frac{4}{8v^3} + \frac{5}{16v^4}$; and thus by supposing the *calculus* to be continu'd in *infinitum*, the infinite series, which we laid down, will come out.

8. For three years, the same denominators and signs remaining, the numerators will be triangular numbers; for four years, pyramidal; for five years, *triangulo-triangular*; and so on for more years, higher numbers, call'd *figurate*; and which I, for their use, am wont to call *combinatory*, in *infinitum*. As this may be shown in the same manner, as I have demonstrated the preceeding conclusion, I wave the prolix deduction of it here, the numbers themselves are as follows: The fourth conclusion.

Figurate or combinatory numbers.						The present value of a principal due		After Years
Unit	1	1	1	1	1	$\frac{1}{2} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000}, \&c. =$	$\frac{20}{21}$	1
Natural	1	2	3	4	5	$\frac{1}{1} - \frac{2}{20} + \frac{3}{400} - \frac{4}{8000} + \frac{5}{160000}, \&c. =$	$\frac{400}{441}$	2
Triang.	1	3	6	10	15	$\frac{1}{1} - \frac{3}{20} + \frac{6}{400} - \frac{10}{8000} + \frac{15}{160000}, \&c. =$	$\frac{8000}{9261}$	3
Pyramid.	1	4	10	20	35	$\frac{1}{1} - \frac{4}{20} + \frac{10}{400} - \frac{20}{8000} + \frac{35}{160000}, \&c. =$	$\frac{160000}{194481}$	4
Triang. Trian.	1	5	15	35	70	$\frac{1}{1} - \frac{5}{20} + \frac{15}{400} - \frac{35}{8000} + \frac{70}{160000}, \&c. =$	$\frac{3200000}{4084101}$	5
&c.						&c. &c.		&c.

Lemma.

9. In order to find after another manner these present values, I assume this lemma: *The present worth of a future value is the present worth of that very sum*: For instance, at the end of the year 1685, or after two years, you shall owe me a certain sum: I would fain know what is now, at the end of 1683, the present worth of that sum; I, therefore, first seek what shall be the value after a year of a sum that falls due after two years, or at the end of 1685, and it will be $\frac{20}{21}$ of the sum (*art. 6.*) because there intervenes only one year: if, therefore, after two years you owe me unity, it is the same thing as to this *calculus*, as if after a year you ow'd me $\frac{20}{21}$; but again, if after a year you owe me $\frac{20}{21}$, it is the same thing (*art. 6.*) as if you ow'd me now $\frac{20}{21}$ of that sum, or $\frac{20}{21}$ of $\frac{20}{21}$, that is $\frac{400}{441}$; if, therefore, after two years you owe me any thing, the present worth will be $\frac{400}{441}$ thereof, or the square of $\frac{20}{21}$, receiv'd of that sum as unity: And in the same manner it will appear, that the present worth of unity due after three years is $\frac{20}{21}$ of $\frac{20}{21}$ of $\frac{20}{21}$, or the cube of $\frac{20}{21}$, that is $\frac{8000}{9261}$, and so on: And this *Lemma* is nothing other than a subsumption from that well known axiom, *that things equal to a third thing are equal among themselves*; for $\frac{400}{441}$ is now equal to $\frac{20}{21}$ due after a year, and this is equal to unity due after two years; and therefore, this unity is equal to $\frac{400}{441}$ due now: Thence now appears

The fifth conclusion.

10. If the rate of interest be v (that is, 20, supposing the interest one twentieth of the principal) *the present worth of a sum due after some years will be to the sum itself in the ratio of v to $v + 1$ (or of 20 to 21) repeated according to the number of years*; that is, the present worth of a sum due after a year will be simply $\frac{20}{21}$ of the sum, or it will be to the sum in the ratio of 20 to 21; but the present worth of a sum due after two years will be $\frac{20}{21}$ of $\frac{20}{21}$, or $\frac{400}{441}$ of the sum, or it will be to the sum in the duplicate ratio of 20 to 21, or as 400, the square of 20 to 441, the square of 21. And the present worth of a sum, due after three years, will be $\frac{20}{21}$ of $\frac{20}{21}$ of $\frac{20}{21}$ of the sum, or $\frac{8000}{9261}$ of the sum, or it will be to the sum in the triplicate ratio of 20 to 21, or as the cube of 20 to the cube of 21, and so on. And by expressing this generally, let the present worth be Z , the sum

sum due S , the number of years a , and v the rate of interest; supposing which, Z will be $= S$, multiplied by the a power of $\frac{v}{v+1}$; let v be 20 and S unit; the present value of unity due after one year will be $\frac{20}{21}$, the root; after two years $\frac{400}{441}$, the square; after three years $\frac{8000}{9261}$, the cube; after four years $\frac{160000}{14641}$, the biquadrate; after five years $\frac{3200000}{16807}$, the fifth solid, &c. which numbers either by multiplication, or only by adding their logarithms, may be continu'd to any number of years; and it will be useful to express the fractions decimally. Of their use in some questions of law, not sufficiently well defin'd among excellent authors; and of estimating annuities for life (where rebate is at compound interest) we shall treat on some other occasion.

Dissertation on Metallic Salts, together with their Uses in Physics, Chemistry, Medicine and Surgery. By Godfrey Rothens. Published at Leipzig, An. 1723.

Translated from the HIGH DUTCH.

SUCH as labour to call in question or entirely to invalidate the existence and reality of metallic salts, principally build on these three things: 1. That the whole of what is usually prepar'd from metals under the name of a salt is no such part as is separated by the way of extraction from their other remaining essential principles, as their sulphur and mercury; but that it is rather the entire body of the metal, corroded by the salts of the *menstruum*'s used thereto. 2. Consequently, that it is only such a combination, as consists of a metallic calx, concreting with salt: Whence it is to be call'd a magistery, or by some other proper name, rather than a salt. 3. On which account also these salts, extracted from metals, when treated with a candent fire, run not as other true salts do, but become either a *calx* (which admits of no farther solution) or a stony *scoria*.

Objections
against the existence of metallic
salts.

2. *Angelus Sala* in his *Chrysologia*^a gives us, as it were, in a short compass, the opposite objections, when he says; 'tho' metallic ashes were for a whole year together macerated in water, yet could not the least particle of a true salt be obtain'd therefrom: I am not ignorant, that there were some who boasted, that, by means of distill'd vinegar, or other the like liquor, they could extract such a salt; but yet I also know, that they egregiously deceiv'd both themselves and others; for, what they gave out for a salt is not really the salt of these bodies, but the spirit of the dissolving liquors, which along with a part of the metallic ashes shot into
' such

Summ'd up by
Angelus Sala.

^a S. I. cap. II. p. 124.

Refuted by the
author.

‘ such a saline mass; as the fire shews, whereby the coagulated spirit may
‘ again be separated from the metallic ashes: So that these ashes, when
‘ thus the spirit is abstracted from them, return again to their firm con-
‘ sistence and form; and are no longer dissolv’d in water.’

3. But the whole of what is here advanced by *Sala* may certainly
very easily refuted; for, the first objection, namely, that the calcin’d
metals, tho’ never so long macerated in water, yield not a grain of a true
genuine salt, may, probably, be granted, as to such metallic *calx*’s, pre-
par’d by bare roasting or calcining: Nevertheless, there are still other
means behind, whereby metals may be reduced to such ashes; which with-
out addition of any one saline or acid *menstruum*, exhibit observable
traces of a genuine salt, of which we shall treat below. The other argu-
ment, namely, that those salts, which in the common method are by the
means of acid *menstruum*’s prepar’d from calcin’d metals, may by the force
of the fire be so separated from each other, that when the spirit evapo-
rates, which the metallic calx had imbib’d, they again resume their former
appearance of a calcarious earth: This argument, I say, may be also re-
futed by contrary and opposite experience; for, tho’ most metallic salts
which also for this reason are by some call’d vitriols, undergo such a change
yet hence we are by no means to conclude, that they are all of the same
nature: Besides, the remaining calcarious body, to which these salts are
chang’d by calcination, does remarkably and evidently differ from the
first *calx*, from which they were drawn, as well in its tenderness, as
its greater degree of solubility; nay, by repeated dissolutions and ge-
neral calcinations (in which great care is to be taken that it does not
vitrify) it may at last be exalted to a higher degree of purity and fixe-
ness than those *calx*’s of the more proper salts require: Besides, the salts
also, which are unanimously so call’d (whence likewise our modern salts
borrow their names, as common salt, salt-petre and the lixivious salts of
plants) give out by the force of the fire a spirit; and there remains be-
hind another more fixt substance, which is distinguish’d from the former
and which is common enough; and in these last, namely, the lixivious
salts, a spirit has likewise been sought for with good success by *Borrichius*.
In regard that from six ounces of the salt from the ashes of the cuttings of
the vine, mix’d with four parts of its own proper ashes, out of which
the salt was elixated, upon distilling it in an earthen retort for 24 hours,
a whole ounce of spirit was forced off, of a moderate sharp taste; upon
pouring which on filings of copper, some vesicles like a rainbow were made
to float in the liquor^b; nay, almost all salts, even the lixivious salts them-
selves, peculiarly call’d *fix’d*, are at last, by repeated calcination and sol-
ution, brought to an useless and insipid earth, as *Borrichius* also testifies.
Nevertheless they are not on that account excluded from the genus or
class of salts.

^b *Vid.* Tractat. de hermet. & Ægypt. Sapient. lib. II. c. V. § 8. p. 366.

^c L. c. p. 253. & cap. VII. § 3. p. 404.

4. In fine, as to that objection, *viz.* that these salts are none of the principles, which constitute metals, and which are separated from the others, but are the entire body of the metal, which is only subtiliz'd and attenuated into a saline form, I say, this objection does not properly affect us, but rather such as attempt to maintain, that all mixts, and consequently also metals consist of salt, sulphur and mercury; and may likewise again be resolv'd into these three principles. Tho' now our present purpose does not admit of our intermeddling with the famous dispute about the principles of natural bodies, or of enquiring, whether the three elements of the Chemists, or those of the *Cartesians*, are more easily demonstrated; yet we hold this as a thing firm and certain, namely, that the genuine principles of mixt bodies are far more subtile than that they can be laid down under the notion and form of a corporeal salt, as it is still subject to a farther resolution and separation: However, the bare distillation of tartar shows, that a mixt, even without its ultimate dissolution into its true and primary principles, may be resolv'd into such parts, as are actually different from each other; as partly into a more acid spirit, a nauseous oil, a fix'd fluid salt, and lastly into an ashy, indissolvable earth; which, indeed, in so far as they may still further be separated into some other foreign parts, cannot be held for the first and true principles; and yet certainly they deserve to be esteem'd and denominated the *principiata*, which in their form, consistence and effects are very unlike each other, and must thus be mutually different: Now when thus the like happens with metals, namely, that they can also be resolv'd into such different parts, what should hinder us from giving different names to their different productions, to distinguish them from each other, tho' the close union of the principles be not essentially sever'd, and a compleat radical dissolution of the mixt be not yet accomplish'd.

5. But in so far as any one is so minded as to clear up the whole of this subject of the chemical principles of things, especially of metals, according to the truth of the matter, he may in this view take *Beccher* for his guide, to whose opinion the famous *Stahl* usually gives in; tho' his sentiment in all respects is not according to the common notions, yet in my opinion he stands upon such a bottom, that I am well assur'd, no one will repent the taking him for his guide much more in this: The saline principle in metals denotes not a perfect and proper salt, which actually consists in a saline mixture (namely, that it is closely united with an humidity) in which form it certainly belongs not to metallic mixtion, nay cannot consist therewith: However, it is such a substance, which in the quickest manner yields to salts, in the sense they are commonly taken, before all other things, and especially above all sulphureous subjects, and unites with them, and if rightly understood, suffers itself, as it were, to be extracted from them. It is certain, that it forms with them such a consistence, as hence to become more

Beccher a proper
guide in this mat-
ter

more proximately fitted to receive any new mixtion; I mean in other metals, that have a great poverty of this saline principle; and to enter more subtilly and closely into them; in which respect the instance of an experiment of *Kunckel's*, to be adduced below, is very remarkable; as also that excellent chemist at *Leipzig*, *M. Lincke*, may supply us with a sample of this matter, namely silver made from common mercury, by means of a very small quantity of a metallic salt; nay, if it were necessary, an experiment might be here adduced, where by means of a gross, nay even a saline mixture, made from lead, copper, &c. such a change is induced on common quicksilver, as eminently shows not only a compleat and genuine, but also the firmest degree of mixtion.

'Tis far from being made out that metallic salts are the body of the metal corroded.

6. Yet the matter is far from being made out, or sufficiently prov'd, that these metallic salts are nothing other than the entire and perfect body of the metal, only corroded and dissolv'd by an acid; and consequently, by means of an alcali, again easily reduced to its former metal; for, tho' some among them may, by means of a particular *encheiresis* in reducing, show something of the former metallic body, yet one may still doubt as to the compleat demonstration of this attempt, even by this reduction itself, till one can be fully assur'd, that by this reduction the full weight of the metal taken thereto is again recover'd, and that a considerable quantity thereof does not change to a glass or *scoria*, or that this reduction may be perform'd without new addition of the more volatile part, which exhald in calcining: Tho' at present we incline not particularly to appeal to the manner mention'd by *Isaac Hollandus*, or any other laborious method of reducing metals, with some separation of other entirely different parts, into a salt; yet here we cannot omit adding, that the gross solution of metals with acid *menstruum's* scarce happens without a manifest separation of adventitious particles. Thus in the common preparation of martial vitriol, that is, in the solution of iron with oil of sulphur, which is diluted with common water, and in filtering it, that it may be fit to shoot into crystals, a loamy, blackish matter at first usually remains behind, which after drying becomes a greyish and very light powder, and by most people thrown away under the name of an useless earth^d; but when examin'd more accurately it appears to be nothing other than the more sulphureous part of the iron, which is left behind untouch'd by the acid of the vitriol, as it takes to itself more readily the saline and earthy parts, and this *Kesslerus* has remark'd^e; nay, when the dried remainder is well ground or rubb'd with about an equal quantity of quicksilver and set to sublime, the greatest part of the mercury concretes with the sulphur, and is rais'd a genuine cinnabar, which, probably, with the same justice as I call a cinnabar antimonial, may also be denominated a martial cinnabar. I have also remark'd, that even such a sediment separates upon making the solution of iron with spirit of salt, yet I have had

^d Vide Glaſer's *Traité de la Chymie*, lib. II. cap. 5. p. 172. ^e Centur. II. n. 27. p. 173.

no opportunity of enquiring into it and treating it in the same manner with quicksilver. Thus also does distill'd vinegar in the solution and crystallization of verdegriſ, leave behind many particles of copper undiſſolv'd, and which are again no otherwiſe diſſolv'd than by the addition of ſpirit of *ſal ammoniac*. Glauber's hint, adduced up and down in his writings, is not entirely without foundation, namely, that ſuch ſediments, as ſettle ſometimes in the different ſolutions and digeſtions of metals, ſhould be examin'd ſomewhat more cloſely and carefully, as this labour may very often be of ſervice.

7. Nay, I ſee not what ſhould hinder, that I may not aſcribe the denomination of a ſalt, even as it is commonly taken, to ſuch a production, as ſhows all the marks of a genuine ſalt, tho' prepar'd without the manifeſt ſeparation and collecting apart of the remaining principles, and tho' the entire body of the metal, or the greateſt part thereof be reduced to ſuch a ſaline ſubſtance. In the ſame manner that we deny not the name of an oil to that of wax or any other ſoft fat; tho' almoſt the entire ſubſtance of the wax or fat, ſubtiliz'd by the motion of the fire, does conſtitute the ſame.

What may be denominated a ſalt.

8. Yet the whole diſpute may be more eaſily decided after premizing the definition of a ſalt, and with this the illuſtrious Dr. *Hoffman* ſupplies us in his Diſſertation *de Generatione ſalium* § 4. where he ſays; 'a ſalt is a ſapid ſubſtance, which ſuffers itſelf to be diſſolv'd in an aqueous liquid;' with whom alſo agrees *Geber*, when in his treatiſe, *Summa perfectio*,^f he thus ſpeaks of ſolution; 'every thing that is diſſolv'd (namely in ſharp, bitter, auſtere and acid waters, ſuch as diſtill'd vinegar, unripe grapes and auſtere plums, &c. when they are previously diſtill'd) muſt neceſſarily poſſeſs the nature of ſalt, alum, or the like': And ſomewhat farther; 'we may from the works of nature ſhow, that barely ſuch things, whoſe ſalts partake of the nature of alum, and the like, do admit of ſolution.'

The definition of a ſalt.

9. Thus it will not be improper to make the principal *criterion* of ſalts to conſiſt in this, namely, that they are eaſily diſſolv'd in an aqueous humidity. The other requiſites, namely, that on the tongue they yield a remarkable taſte, that after ſolution in watery *menſtruum*'s they may again be eaſily reduced to a dry conſiſtence, when duly evaporated, are rather ſecondary and improper characteristics; their remaining properties, as their colour, fixedneſs or their abiding the fire, their purity and fluidity are only accidental diſtinctions, which may, indeed, alter the *ſpecies*, but in no manner, the *genus*; in which reſpect, ſugar, tartar and other ſalts, call'd the eſſential ſalts of plants, vitriol, alum and other ſuch like, are certainly to be reckon'd in the number of ſalts. In no other manner does *Baſil Valentine* uſually ſpeak, who, as *Helmont* and *Borrichius* teſtify, was almoſt the very firſt that introduced the appellation and diſtinction of the three principles, ſalt, ſulphur and mercury; for, thus he writes in his third book

The principal ſecondary and accidental characteristics of ſalts what.

of vitriol, p. 270. 'in the earth is a mineral salt, call'd vitriol, &c. this salt carries an inflammable sulphur, which the others do not.' Also in his *repetition of the stone of the wise*, p. 106. on tartar; 'this salt is not written in the book of minerals.'

Vitriolic salts or crystals how obtain'd from gold, silver, &c.

10. Thus if one could only obtain from metals a vitriol, it would be a sufficient refutation of those of an opposite opinion; for, they themselves venture not to deny, that all metals, even the nobler sort, which otherwise do without any waste withstand all force of fire, may by proper *menstruum's* be reduced to vitriols or saline crystals, tho' as to gold the matter is not so easy, upon exposing plates of gold to the fumes of corrosive waters, as the generality do with this view recommend it: However, *Erbineus von Brandau* in his *twelve fundamental pillars of nature and art*, p. 23. proposes a speedy and no improper method of reducing not only gold, but likewise silver and mercury to such crystals or vitriolic salts; namely, the gold is dissolv'd in *aqua regia*, but the silver and mercury in *aqua fortis*; then the *menstruum's* are drawn off to about the half, and to the remaining liquor some spirit of wine is dropp'd (for, without the addition of this latter, the solution of the gold made with *aqua regia*, does with difficulty shoot into crystals, as *Cramer* testifies^z) upon which in a cool place it shoots into transparent crystals, which then may a-new be dissolv'd in distill'd vinegar, afterwards in distill'd rain-water and spirit of wine: And by these repeated solutions and coagulations they may be brought to the greatest purity^h.

From lead.

11. Such a vitriolic salt may more readily be obtain'd from lead, by means of distill'd vinegar, when pour'd on *minium*, litharge, cerufs, or any other calx of lead, as being soonedulcorated thereby; and afterwards being duly evaporated it gives a salt, which on account of the peculiar sweetness it yields in the taste, is commonly wont to be call'd sugar of lead; nay, it is still more easily prepar'd, without any preceeding calcination, from filings of lead with small *aqua fortis*, or such as has been diluted with about three parts of common water; nay, even a somewhat stronger vinegar, when distill'd thro' a lead-alembic, or such as is fill'd with sheet-lead, carries along with it so much of the lead, that the vinegar becomes not only observably sweet, but when it is also abstracted or duly evaporated, it shoots into saccharine crystalsⁱ. In this manner *Zapata* prepares his *aqua Æsculapii*; for, that it is nothing other than a fluid sugar of lead, may be easily shown from the circumstances mention'd by the author himself, see his *Mirabilia Medico-chirurg.* publish'd by *Spleissius*^k.

From tin.

12. That from tin in the same manner as from lead, a salt may be extracted with distill'd vinegar, *Glafer*, indeed, denies in his *Traité de la Chymie*.

^z Colleg. Chym. p. 120.
on gold-making, p. 107.
Glass-making.

^h Vid. *Kessler* Cent. 1. n. 4. and *Bar. Schroeder's* thoughts

ⁱ Vid. *Kunckel's* Remarks on *Neri's* and *Mérret's* Art of

^k Cap. XIII. p. 220.

*Chymie*¹. But upon taking good sharp distill'd vinegar, to which in the distillation about a handful of common salt has been added, and pouring it upon *calx* of tin, prepar'd by bare ignition and a constant stirring it, and afterwards suffering them to digest duly together for some time, it indeed, takes so much to itself, that upon dropping some spirit of vitriol into the solution, it strait becomes muddy and precipitates. In this manner *Mynsichtus* prepares his *sal* or *magisterium joviale*^m.

13. From copper, a vitriolic salt is very commodiously obtain'd, if it be cemented and calcin'd with common sulphur; for, the spirit of vitriol lays weak hold on the copper, so that a pound of it scarcely takes to itself half an ounce of copper. From verdegris also with distill'd vinegar green crystals are usually made, and sold by druggists under the name of distill'd verdegris. The green precipitate of *Beguinus* and *Hartmann* for the clap, differs little from this.

14. In the same manner may from iron, as from copper, a vitriol be prepar'd by cementation and calcination with sulphur; nay, as *Glauber* writes, it may also be easily obtain'd by barely conveying the fume of burning sulphur to some iron-filings, put in a capacious alembic; nay, even by mixing iron-filings with pounded sulphur, and barely sprinkling it with water, it will in a few hours so heat as to burst the glass, and yield a very thick fume, and lastly become a brown powder, which by gentle roasting in an open vessel changes to a beautiful red *crocus*, from which afterwards with rain-water a vitriolic salt of no ungrateful taste may be extractedⁿ. Nevertheless, iron does easily and readily yield to the spirit or oil of vitriol, when diluted with about three parts of common water, which is also the most common way of preparing a martial vitriol or a vitriol of iron. Yet in this preparation there is this remarkable; namely the spirit, nay, even the oil of vitriol itself does often obtain partly, thro' the more immediate communication with the glowing matter in the distillation, partly by the addition of an inflammable, vinous spirit; nay, even barely by the abstraction thereof from common mercury (which happens in the preparation of turpeth mineral) a peculiar volatility and such a penetrating force, as that it can scarce in any manner be check'd from yielding thro' the junctures a very sulphureous fume, which almost stifles the by-standers; but which, upon only putting into the receiver some fresh iron-filings, that are not rusty, is immediately entangled and concentrated into a beautiful vitriol.

15. But as for the most part these vitriolic salts, prepar'd from metals with acid *menstruum*'s, have a very nauseous and austere taste; nay, some of them, a very strong septical or corrosive virtue, some have attempted to correct them in some measure, and render them fitter for medicinal use, partly by repeated solutions in distill'd vinegar and distill'd rain-water,

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and

¹ Lib. 2. cap. IV. p. 160. ^m Armamentar. Medic. chymic. p. 21. ⁿ Vid. Hoffmanni Notas in *Poterium*, p. 553.

These vitriolic salts how corrected.

and partly by the addition of spirit of wine, or a volatile, urinous salt; and indeed, as to spirit of wine, its effect in weakening, or, as it is commonly call'd,edulcorating or dulcifying the strongest acids and corrosives, as for instance, oil of vitriol, concentrated spirit of nitre, &c. is well known. *Basil Valentine* has mention'd of distill'd vinegar, that it is the best corrective of all mineral poisons especially; and he also adduces an evident experiment, that is well worth to be considered, whereby distill'd vinegar weakens, nay, entirely changes glass of antimony and other strong antimonial emetics^o; nay, the above-mentioned precipitate is usually so prepar'd, that the mercury and copper are dissolv'd in *aqua fortis*; afterwards the *aqua fortis* is abstracted therefrom, but what remains behind is dissolv'd in distill'd vinegar, and very seldom causes either vomiting or salivation: Whereas the former effect is otherwise very common to copper, and the latter, to quick-silver after solution and precipitation in *aqua fortis*; and certainly the peculiar and mutual changes, which distill'd vinegar both shews in and again suffers from metals, but especially lead, copper and iron, deserves mature consideration, as appears in different manners in sugar of lead, crystals of verdegris, different *crocus*'s and precipitates both of iron and copper. We must not disregard the commendation *Isaac Hollandus* bestows on distill'd vinegar, when he assures, that above other *menstruum*'s it is possess'd of an eminent virtue of penetrating metals, volatilizing, rectifying and again fixing them^p.

Whether spirits
are fitted to cor-
rect these salts.

16. But that spirits, or volatile, urinous salts should be fitted to correct these vitriolic salts, some might, probably, call in question on this account, namely as it may be apprehended, that these salts may be destroy'd by the addition of an alkaline liquor, in regard the metalline particles, concreted with the acid *menstruum*, are again torn and separated from their union and combination. But this apprehension is groundless; for, copper, if only dissolv'd with common *aqua fortis*, is not precipitated by spirit of urine or *sal ammoniac*; or if at first any of it be precipitated, it is again strait dissolv'd, upon pouring in a larger quantity of the spirit, whereby the colour is then very beautifully exalted; so that the liquor, that was before entirely greenish, does now give the most beautiful, blue saphirine tincture. The only thing that seems to be still wanting is, that this solution cannot easily be reduced to crystals of the like colour; for, upon evaporating it even in the gentlest manner, or abstracting it in close vessels, the beautiful blue colour soon vanishes, and there remains behind a greenish saline *magma*, that with great difficulty coagulates; but urged with a stronger fire, fulminates in the most violent manner, to the endangering the by-standers. *Stiffer* also owns^q, that he found no less difficulty in the solution of *Cyprian* vitriol, which in like manner, upon his dropping an urinous spirit thereon, instead of

^p Vide *Valentin. de magno lapide antiquorum Sapientium* p. 107. *et Currus triumphalis antimonii*, p. 390. ^q Vid. *Stabl. Specim. Becher. P. II, memb. 2, exper. 199. — 209.*
^a *Act. labor. chym. specim II. cap. XI.*

of precipitating or becoming muddy, was exalted to a very beautiful colour, but could in no manner be brought to shoot into crystals; yet he mentions, that after several fruitless attempts, he at length accomplish'd it by means of a liquor, neither acid and corrosive, nor alkaline and lixivious, which the author in the above-mentioned place does not, indeed, expressly mention, yet it has long since been conjectured by the experienced to be no other than a rectified spirit of wine. *Glauber*, in his *Philosophical furnace*^r, as also in his *Prosperity of Germany*^s, shows very clearly, how vitriol of silver, prepar'd with oil of vitriol or *aqua fortis*, may by means of spirit of urine be corrected.

17. I know not whether we may here refer the correction or exaltation of such vitriolic salts, as some have attempted by the addition of other salts. Thus we find in *Digby's* experiments p. 189. how to correct the crystals of silver by the addition of saltpetre, so that thereby their diuretic virtue may be the milder and more safe. *Rebure* teaches, that from iron by means of *aqua fortis*, alter'd by a little salt-petre, may be obtain'd genuine crystals, which are also proper to be taken internally. *Cassius* in his treatise *de auro* cap. x. p. 109. changes gold itself by means of the phlegm of *aqua fortis* and sea-salt into very red crystals, which smell of violets and have no ungrateful taste; and tho' in this manner they might with better success be us'd in medicine, yet, probably, they will be the less receiv'd by others, as foreign salts are very evidently added to them.

Whether vitriolic salts may be corrected by other salts.

18. But to omit those vitriolic salts and to proceed to such as are generally held to approach nearer to genuine salts; *Geber*^t plainly shows the method of obtaining them, when he says; 'we may from the works of nature show, that barely such things, as possess the nature of salts, alum and the like, suffer solution, &c. and such as are thus dissolv'd must necessarily be so by virtue of their nature. But as we see, that all such things, as are duely calcin'd, are by the repetition of the calcination and solution dissolv'd; it will hence be manifest, that all calcin'd matters approach nearest to the nature of salts and alum'.

Salts which approach nearer to genuine salts, obtain'd by calcination.

19. And thus, as it were, calcination is the shortest and speediest key for opening the firm locks and bolts of metals; but calcination, even as *Geber* describes it^u, is a pulverisation of a thing by means of fire, whereby the humidity, which held together or combin'd the parts, is dissipated. But now this happens in a twofold manner, as he there also shows p. 100, either barely by the fire, or by the acrimony of the salt: Both methods are describ'd by *Isaac Hollandus* in a particular treatise he wrote on *the salts and oils of metals*; and he holds, that the former answers better in the harder, and the latter in the softer metals; namely gold, silver, tin and lead are dissolv'd in their proper acid *menstruum's*, and afterwards precipitated;

Calcination of metals what, and how perform'd.

^r Lib. II. p. 19.

^s Part IV. p. 68.

^t Summ. perfect. lib. I. cap. LI.

^u Cap. L. p. 98.

rated; the calx elixated from all its salt, is then put into cucurbites with flat bottoms, not exceeding a finger in thickness; and then it is kept for 20, 30, nay more days in such a degree of warmth, as is necessary to make the lead run, yet without igniting it; after that, the fire is gently increas'd to ignition, and continued at that pitch above eight days; and the more volatile part, which he calls a mercury, rises up in form of white flowers, and the calx remaining behind at the bottom swells or heaves like a sponge; and when this happens, the salt is drawn off with distill'd vinegar; and what is brought over is purified by repeated solutions and coagulations; but the harder metals as copper and iron, are filed small, and then reverberated by a bare slight ignition; but for a longer time, as 30, nay 90 days successively, till they also heave and swell like the former; and then the salt is extracted with distill'd vinegar. But certainly this operation requires an uncommon degree of patience, and an entirely accurate regimen of the fire (and here the author very justly hints, that one must take particular care, that the metals do not vitrify) and hence he had so few followers; nay, it has hardly been believ'd by a great many. But yet, that this manner of opening and subtilizing metals by such a continued reverberation does thus succeed, is confirm'd by Kunckel's own experience, when he says, 'that iron-filings, when treated in this manner, become a subtile *crocus*, which, as he hints, contains more in it than is proper to reveal'.

Monte Snyder's method.

20. Monte Snyder's method has been more generally receiv'd, (probably, as the process is much easier and more compendious) wherein he mixes the metals with the *regulus* of antimony, and then resolves them by means of salt-petre, tartar and sulphur, mixt together in a due proportion; in such manner, that after the salts which were added are elixated and the sulphur separated from the remaining calx's, after being first open'd by further calcination, the salt may at length be extracted; as this is more fully explain'd, partly by the author himself, tho' somewhat more darkly, and partly by his Commentator *Berlichius*, both in his remarks annex'd to *Monte Snyder's* treatise, and also in his inaugural dissertation *de Medicina universali*, An. 1679 at *Jene*. But as the illustrious *Stahl* hints in his observations for the month of *April*, scarcely can any other thing be obtain'd in this manner than beautiful clear crystals, and which also *Berlichius* himself does not entirely deny, only that he would maintain, that they are possess'd of a greater degree of fixedness and fluidity.

Instead of salts, &c. other minerals, nay metals themselves might be employ'd.

21. Yet one might justly wonder, why the artists did not, instead of salts and common sulphur, employ other minerals, or even metals themselves for the purpose. It is well known, that tin and lead do in a gentle fire melt very well together and run into each other; but as soon as the heat becomes glowing, that the vessels are ignited, they so heat each other, as to glow like a burning coal, and presently fall to ashes. Thus it is also very

^w *Vide* his Art of Glass-making, p. 69.

very remarkable of zink, that when laid in bits on any metal, as for instance hot running lead, it strait breaks out into a very clear bright flame; and by a copious evaporation of very white flowers, it at last changes with the metal to a very light and highly tender white powder. And I remember not to have found any trace of this in any other author than in the latter part of *Beccher's Concordantia Chymica*, which he calls *rosetum chymicum*^{*}; where he teaches, how to convert gold itself into a yellowish calx, without any lustre or splendor, upon mixing about three parts of zink with it, and again subliming it from the gold with the strongest degree of fire.

22. The following method is the more usual and better known, for the more accurately attenuating and opening metals; namely, by often abstracting and subliming mercury therefrom. Thus *Etmuller*^y recommends, when one would further chemically edulcorate a calx of gold, made with *aqua regia*, and dulcified with common water, the *Mercurius dulcis* should be added in equal quantity, and by a continu'd careful rubbing be well mix'd together, and afterwards again sublim'd from the calx of gold, and the gold will remain behind like a wool; and it afterwards will become the fitter for the extraction of the tincture, and also, doubtless, of the salt. That corrosive sublimate will be still more powerful, so that without a previous solution of the metals in *aquæ fortes* it will be alone sufficient, will be easily granted by such as know the power of *sal ammoniac*, or even arsenick itself in this case; tho' this method will be the less agreeable to such as would have absolutely no acid us'd therein, the more evidently the salts combin'd with the sublimate do here operate.

The more usual method of calcination what,

23. Thus most people have chose to use running quicksilver, which method *Atremontius* also shews, as author of the *French* treatise, entitled the *Grave of poverty*, and which *Borrichius* (as the method is somewhat obscure in the above-mention'd treatise) as it was communicated to him by the author himself, has plainly enough shown in his *Conspect. Chymicor. illustr.* § 57. p. 38. and from which is not very different the process describ'd by *Beccher* in his *Tripod. hermet.* under the following title *Concord. mercur. Lunæ, lit. Y.* p. 170. And which, as he mentions, was communicated by *Kesslerus* and *Claustus*, body-physician to the Emperor *Ferdinand III.* Yet it stands still more clearly and evidently explain'd in the works of *Angelus Sala*, p. 290. under this title, *Spiritus solis Johannis Osiandri*, Superintendant at *Murbach*; namely, the gold is beat into very thin plates, amalgamated with running mercury, and the superfluous mercury strained from it thro' leather; the mass, remaining behind in the leather, is put into a glazed test on glowing coals under a glass-helm, to catch the mercury, as it flies off, and that it may again be separated from the amalgam; the necessary *encheiresis* here, as *Beccher* remarks, consists in this, that between the helm and the earthen vessel, wherein the amalgam lies,

The method of calcination with running quicksilver how perform'd.

^{*} N. 3. p. 792.

^y Colleg. pharmac. *Schroed.* S. III. c. X₄

lies, a space of a finger's breadth be left, that the mercury may fly off the quicker, and settle in the helm: But before the mercury is half or entirely evaporated, the mass of gold must be taken from the fire, and again rubb'd, that it may not run or cake together, a thing that must be very carefully avoided. After that the mercury is entirely driven off, to the remaining *calx* must be again added fresh mercury, or even the former mercury, and be again separated therefrom by the fire; and this must be so often repeated, till at last the *calx* will receive no more mercury. In the process it is not even necessary, that the mercury, which in amalgamating was again added to the gold, be entirely separated therefrom; for, it is no hinderance, tho' some of it still remain behind along with the gold. Now, when the *calx* of gold receives the mercury, either with difficulty or not at all, then all the mercury is entirely separated from it by the heat, only you must take care that the *calx* does not run; this *calx* is in some measure reddish; and on it is pour'd distill'd vinegar, which extracts from it what the mercury has prepar'd for solution; and then to the remaining *calx* either the former or even fresh mercury is again added, which it then (a thing to be wonder'd at) very quickly receives again; and then in the same order the first process is repeated, till the entire *calx* of gold be in this manner resolv'd, which yet can be no otherwise effected than by many and those often repeated processes. The vinegar, employ'd in the solution, and which was afterwards decanted off, is pour'd together, and then evaporated with a soft fire over the ashes; and there remains behind at the bottom a salt, which may be dissolv'd a-new and purified in distill'd rain-water. This salt, after drying and distilling it in a retort, yields a very penetrating spirit that smells like saffron; at the bottom there remains behind an ash-colour'd *caput mortuum*, from which again a salt may be extracted, far exceeding the former in purity and fixedness.

Osiander's method of resolving gold and silver how perform'd.

24. That resolution of gold and silver, sought after by *Lucas Osiander*, brother to the above-mention'd *Job. Osiander*, publish'd by *Job. Ulric. Reschius*, under the title of *Osiander's Experiments*, and illustrated with many examples, is only in some circumstances different from the former; namely, that author made an amalgam of one part of purified gold, and the superfluous quicksilver he then strained from it thro' leather, and put what remain'd into a glass-phial, coated externally with lute, and pass'd it into a common pot, whose bottom was struck out, and applied to it the flame of a lamp, whereby all the quicksilver, or the greatest part thereof, was evaporated; so that the gold remain'd behind like an ash-colour'd, or fallow-brownish ball. As this happen'd, he took out the ball, before the glass cool'd, and before it had cak'd too close to the glass, he ground it and again added some quicksilver, as also common water, and rubb'd them so long, till the water pour'd on became black; and then decanting it off, he pour'd on fresh: And this he so often repeated, till in the rubbing no more

more blackness was to be seen. The amalgam thus wash'd he treated again in the preceeding manner, till the whole substance of the gold was converted into such a black powder; this black and very tender powder, when gently ignited, as he testifies, in a crucible, so that the common mercury still adhering to it might evaporate (which may again be recover'd by setting about the separation in a glass-retort) acquires a dark-yellow colour, but is depriv'd of all splendor, and can never again be reduced to gold, but changes to a green-colour'd glass like an emerald, when the reduction is attempted both with extemporaneous and common salt of tartar; but when often extracted with distill'd vinegar, it is at length entirely converted into a salt of some service in medicine; and the same thing also happens with silver, if we only observe, that the water, with which the amalgam is elixated, and the powder itself, which is wash'd from the amalgam, is not so very dark; but when attempted to be reduced, it becomes a yellowish glass, or of a hyacinthine colour.

25. But however, as there are some of so delicate a taste, as that they cannot well bear the least acrimony, such as distill'd vinegar is possess'd of, and which is usually employ'd for the extraction of this salt; to give satisfaction to such, and to cut off all further occasion of exception, we shall only adduce the remark of the laborious *Borrichius*, whereby it has been found, that the very water, with which such amalgams are wash'd, after the blackish powder is separated therefrom, and when the water is evaporated by a gentle warmth, yields forth some pure salt, which, upon taking pure distill'd water thereto, could proceed from nothing other than from the metal, which by this repeated grinding with the quick-silver is in some measure opened. *Borrichius* in his treatise *de Hermet. & Ægypt. Sapient.* writes thus; ‘ I make an amalgam of four parts of highly purified quick-silver, and one part of gold, previously well refin'd by means of antimony; on which amalgam I pour distill'd water, and for a long time rub and grind it in a glass-mortar, so often as I have leisure. In the meantime I daily, nay hourly observe, that somewhat of a darkish body does from the rubbing appear in the water; now when the water appears to be sufficiently saturated with this blackness, I pour it off into a clean glass; and in a little time, when the black powder has settled to the bottom, I again pour upon the amalgam the clear water floating a-top; I rub it, as before, repeatedly: After some days, when the blackish powder no more appears so plentifully on the rubbing, I again put to it some very pure quick-silver, that the amalgam may become the softer, and the metallic powder adhering to the glass-pestle may the more accurately be divided: And thus continuing the process for some weeks, I dry the black powder in the heat of the summer-sun, and in different manners I attempt its reduction to gold; but I could not hitherto accom-

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‘ plish it, what *encheireses* soever I employ’d. The distill’d water so often
 ‘ pour’d upon it, I caus’d gently to evaporate, and it left behind at the
 ‘ bottom some grains of a crystalline salt. The thing happen’d in the
 ‘ same manner with silver, and still somewhat quicker; but the powders,
 ‘ forced from the silver, are not blackish, but rather of an ash-grey colour:
 ‘ But so far as I know, they, like the former, suffer themselves in no man-
 ‘ ner to be again reduced to silver. White-lead, call’d now-a-days tin,
 ‘ does also yield by this rubbing such a blackish powder, greatly refem-
 ‘ bling that from gold. Filings of copper, when rubb’d for two days,
 ‘ become a genuine amalgam; tho’ this is hitherto unknown to most peo-
 ‘ ple; and it leaves behind in the water at first, indeed, a blackish powder,
 ‘ which in continuing the rubbing becomes almost yellowish. Black-lead
 ‘ or lead separates in the water white flakes, and that pretty copiously. The
 ‘ water, employ’d in the rubbing to each amalgam, when gently evapo-
 ‘ rated, leaves behind at the bottom some genuine acrid salt. But that no
 ‘ one may imagine, that either the black powder or the salt proceeds from
 ‘ the quick-silver, employ’d in the operation, he must know, that I could
 ‘ never hitherto force any one of them from it, when it is well purified,
 ‘ tho’ I have for a long time repeatedly rubb’d and ground it by itself in a
 ‘ mortar with distill’d water.’

Instead of *Borri-
 chius*’ method,
 digestion may be
 us’d.

26. Instead of this very operose and tedious rubbing, digestion may be employ’d; in which, notwithstanding, such a degree of warmth must be kept up, that the quick-silver may be ready to sublime, but yet little of it actually be rais’d; and when continued a day and a night, or even for a longer time, the amalgam will be cover’d with a blackish skin; and then it is taken out, and rubb’d for a long time in a strong mortar with distill’d water. And much of the blackish powder goes into the water, which is then decanted from the black powder, either as the powder settles of itself to the bottom, or it is filtred, and evaporated with a gentle fire; and it leaves also behind some genuine salt, tho’ such find themselves much mistaken, as expect a great quantity from it; yet if any one, as *Borrichius* hints, would instead of distill’d water make use of vinegar, or only the phlegm of vinegar in the rubbing, he will certainly obtain a greater quantity of salt: In like manner when the black powder, separated by the washing, is dried and put into a glass-retort, to separate the quick-silver that still adheres to it, and if it be afterwards roasted by a gentle ignition in an open vessel and carefully stirr’d, and at last extracted with distill’d vinegar, it will also yield a larger quantity of salt, tho’ we are not ignorant what either may or is usually excepted to this method; yet it is certain, if I may venture to speak the truth of the matter, that such seek for and make difficulties where there are none, and lose their labour besides, as in the resolution of metals not only reject, but entirely abhor all addition of any, nay the weakest acid.

27. But

27. But as we leave every one to his own judgment, so we now address our selves to add something as to the use of this salt; and this use regards partly physics and chemistry, partly medicine and surgery. As to the first, the great promises of some about it are well known; namely, that the salt of metals is the *philosopher's stone*: Now, tho' *Isaac Hollandus* expressly ascribes to his metallic salts (and even to those prepar'd from the ignobler metals) the power of tinging and of fixing mercury; to whom also among the moderns *Kunckel* with his own experience agrees, as he relates it in his chemical remarks^a, in these words; ' I know how to make a salt from metals, which is somewhat operose in a laboratory out of a glass-house, or the like constant fire. This salt, does like other salts, suffer itself at first to be dissolv'd in vinegar or to be extracted with it, and it also passes along with it thro' the filtre; but after it once shoots like an *alumen plumosum*, neither vinegar or water any longer dissolve it, nor will it melt in any fire, except in a very vehement one, where it becomes a milk-colour'd glass: And this has much employ'd my thoughts. But as I brought about its solution in water, I pour'd it on highly purified and volatile mercury, till I forced the water from it in the warmth; and in the reduction I had a brittle mass, which, after a number of fusions and separations, yielded about 2 $\frac{1}{2}$ *lots* (or half ounces) of the finest and most beautiful silver'. Yet these authors ingenuously own, that these their salts still want much to entitle them to that name. And thus it may be sufficient, that we here advance what *Geber* in his *Summ. perfect.*^b has said of this matter both modestly and significantly; ' but the reason that solution has been invented has been the subtilization of such matters, as have no proper flux or ingress, on which account the great use of the spirits and of those things which are of their nature is lost; for, every thing that is dissolv'd must necessarily be possess'd of the nature of salt, alum, or the like; but their nature is, that they give fusion before their vitrification: And thus in like manner spirits dissolv'd cause the like flux (fusion) and now as, according to their nature, they greatly agree with bodies, and also mutually with each other, when they have acquired their flux, it is necessary that thereby they penetrate bodies, and in penetrating also transmute them'.

The use of this metallic salt what?

Its tinging and fixing mercury.

Metallic salts how beneficial in medicine.

28. And even this subtilization of metals, adduced from *Geber* and recommended by him under this operation, affords no small light to such as enquire what advantage may be expected therefrom in medicine; for, this reduction of metals into salts may either so happen, that such salts are extracted and separated therefrom, or they may now be attenuated and transmuted; and it is evident, that in both manners they become more adapted for medicinal use; in regard that in this case both the speedier solution, as also in the other case, the separation of the too volatile parts and the earthy impurities

^a Part I. c. V.

^b Lib. I. c. LI.

purities, and the thence arising genuine agreement of the fixt and volatile, do both promise and cause a more successful and beautiful effect.

A particular circumstance adduced by *Claveus*.

29. It is certain *Claveus* in his book *de artificio produc. lap. philos.* adduces a particular circumstance, which, at least conditionally taken, in its kind deserves to be well and accurately weigh'd; as he assures, that the metallic tincture, when brought to such perfection, as duly and thoroughly to tinge metals, is far from being proper in medicine, so as to be salutary to the bodies of men; but for this end it still requires, that the fifth degree of fire be continued many days longer, and at last it be thus calcin'd, and by this force of fire be so attenuated, as quickly to relent in any potable liquor; that is, be reduced to a genuine, compleat, saline nature and essence. However, here the matter rests on the author's fidelity and credit: And to conclude, in that case the known saying might, without any straining, hold good and true, and which *Claveus* often alledges, namely, that *the salt of metals is the stone of the wise*.

The principal effect of vitriols consists in their contractile force.

30. However, as so small a quantity of these salts is acquir'd, and their preparation is not particularly known and common, this has been the reason that they have not been employ'd for different medicinal purposes, and that their virtues, as they deserve, could not be examin'd by repeated experiments. On the contrary, practical physicians have hitherto employ'd, and that not without success, the other vitriolic salts; but the principal effect of almost all such vitriols consists in their contractile force, accompanied with a peculiar corrosive virtue, which is more or less evident; and this is strongest of all to be found in crystals of silver and vitriol of copper; but in the vitriol of gold it is milder; and still more so in the vitriol of iron, as being rather possess'd of a contractile earthy virtue, in which the sugar of lead excells all others.

Their external use in ulcers.

31. They have also their use externally in all foul and running ulcers; a no contemptible thing, in regard they cleanse them by their corrosive virtue, and by their corrugating hinder the flux of the humours; and thus they heal: Hence I also remember, that in all, nay in cancerous ulcers, the late Dr. *Petermann* of *Leipzig* particularly recommended the vitriol of gold, before all other cleansing medicines. And this is also hence confirm'd, that M. *Belieur*, a surgeon of *Paris*, us'd an oil of gold, or rather a vitriolic liquor, prepar'd from gold with spirit of nitre and salt (as it is describ'd in *Digby's* experiments, publish'd by *Hartmann* and *Langius*^c; and again in the *Medicina experimentalis Digbæana*, publish'd at *Offenbach*^d) in all malignant, venereal, nay and cancerous ulcers; and thereby compleated a cure in a very short time; which, as I myself know, is also found confirm'd by the proper experience of another; nay, I remember, that the bare and slight solution of iron, made with vinegar, has very speedily cur'd ulcers in the throat, which are otherwise very obstinate. However,

^c P. 219.

^d P. I. p. 79.

one must previously well consider, whether it be entirely of service so quickly to repel and heal up old ulcers ; for, there are many instances of pernicious, nay fatal consequences from speedily drying up old ulcers and sores in the bones, as to both which a physician must use the greatest precaution. And a like circumspection is also necessary in inflammations, and especially in those of the eyes, which are commonly repell'd with sugar of lead and other vitriolic matters ; and such cure is not to be undertaken without the preceeding, concomitant and subsequent internal use of deterging, laxative, and inciding medicines ; or the regarding not so much the alleviating and removing the pain, as the dissolving the stagnation of the blood. And we are also to remember, that in scars and films of the *cornea* of the eye, which are usually remov'd with vitriol of copper, we do not undertake the cure without premising the *universals*, as they are call'd. And as the sugar of lead is otherways not improper for obviating and allaying pain and the flux of humours, which otherways ensue on the use of corrosives, but cannot well be mix'd with the vitriol of copper without precipitation, so in this case you may first pour into the eyes some drops of the solution of vitriol of copper, and in some minutes after, some sugar of lead, dissolv'd in rose-water.

32. As to their internal use, the vitriol of gold has a purging, as also a ^{Their internal} strengthening quality, as is expected from using it against the worms : ^{use.} And this virtue the vitriol of iron, tho' in a less degree, is possess'd of ; whence it is not improperly added to aloetic laxative pills, cachectic powders and other medicines for promoting the *menses*, and against the hypochondriac affection. The vitriol of silver is a strong diuretic, so that many are of opinion that it cannot with safety be taken internally : But that it is also possess'd of a peculiar virtue in correcting a vitiated imagination, besides the known commendation of the tinctures of silver, is confirm'd by the testimony of a famous physician in his successful cure of some mad people ; for, he assur'd Dr. *Stahl*, that in the curing of madness he depends on no one medicine so much, as on these vitriolic crystals of silver. The internal use of vitriol of copper is justly discharged, as it is a strong corrosive and emetic. But what *Beguinus*, *Agricola*, and others ascribe to it (when mix'd with quick-silver and a-fresh dissolv'd and corrected with distill'd vinegar) for compleatly curing a contagious, nay even an inveterate clap may be seen in these authors : What *Stiffer* promises of it in the cure of the epilepsy is also well known, when by means of spirit of wine and urine, it is converted into blue crystals, and again dissolv'd in a proper distill'd water. Now tho' a proper and careful use thereof cannot be entirely rejected ; and tho' in a smaller dose it proves no emetic, nor causes any other hurt ; yet practice shews, that when given in somewhat too strong a dose, it is not depriv'd of all its emetic virtue. *Mysicetus* salt.

or

or magistery of tin is recommended by *Baglivi* in his *praxis* ^c, as an approved specific in hysteric fits. The sugar of lead is usually, indeed, very much commended by several in madness, a virulent *gonorrhæa*, &c. for allaying inward heat. But upon considering the highly pernicious and almost fatal consequences, caus'd by recovering sour wines with litharge; nay, he who only considers the manifest vitiation and loss of appetite, tho' otherways pretty strong, usually caus'd by a few doses only of the vitriolic tincture of lead in a consumption, will, doubtless, allow, that the sugar of lead is rather to be us'd externally in surgery, than internally in medicine.

(Conclusion.

33. But if any one inclines to have a regard to such as promise something still higher, he may consult the above-mentioned *Claveus*, who in the above cited place says; 'our gold-making salt, or the *stone of the wise*, 'is the true *aurum potabile*, which is solvable in any one liquor; and is, as 'they say, the most excellent and noble medicine for curing the most 'dangerous and mortal diseases. I have always held, that one must particularly abide by this salt, &c.' As for the rest, as I have not hitherto experienced the truth and certainty of this matter, so I will advise no one to apply himself to the pursuit of it, without the greatest prudence and circumspection.

^c Lib. II. cap. IX. § 5. p. 209.

A very easy and cheap Remedy in a Gangrene; by Tho. Bartholin, together with Observations thereon; by Phil. Jac. Sachs à Lewenheim. From the Miscellanea Naturæ Curiosorum. An. II. Dec. I. Obs. II. p. 2.

Translated from the LATIN.

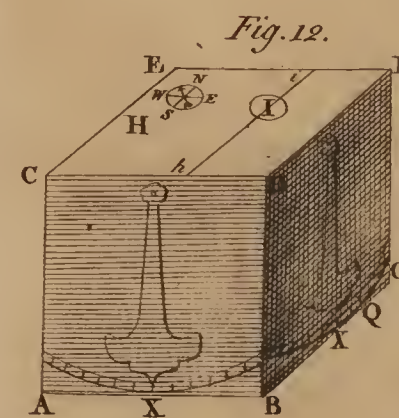
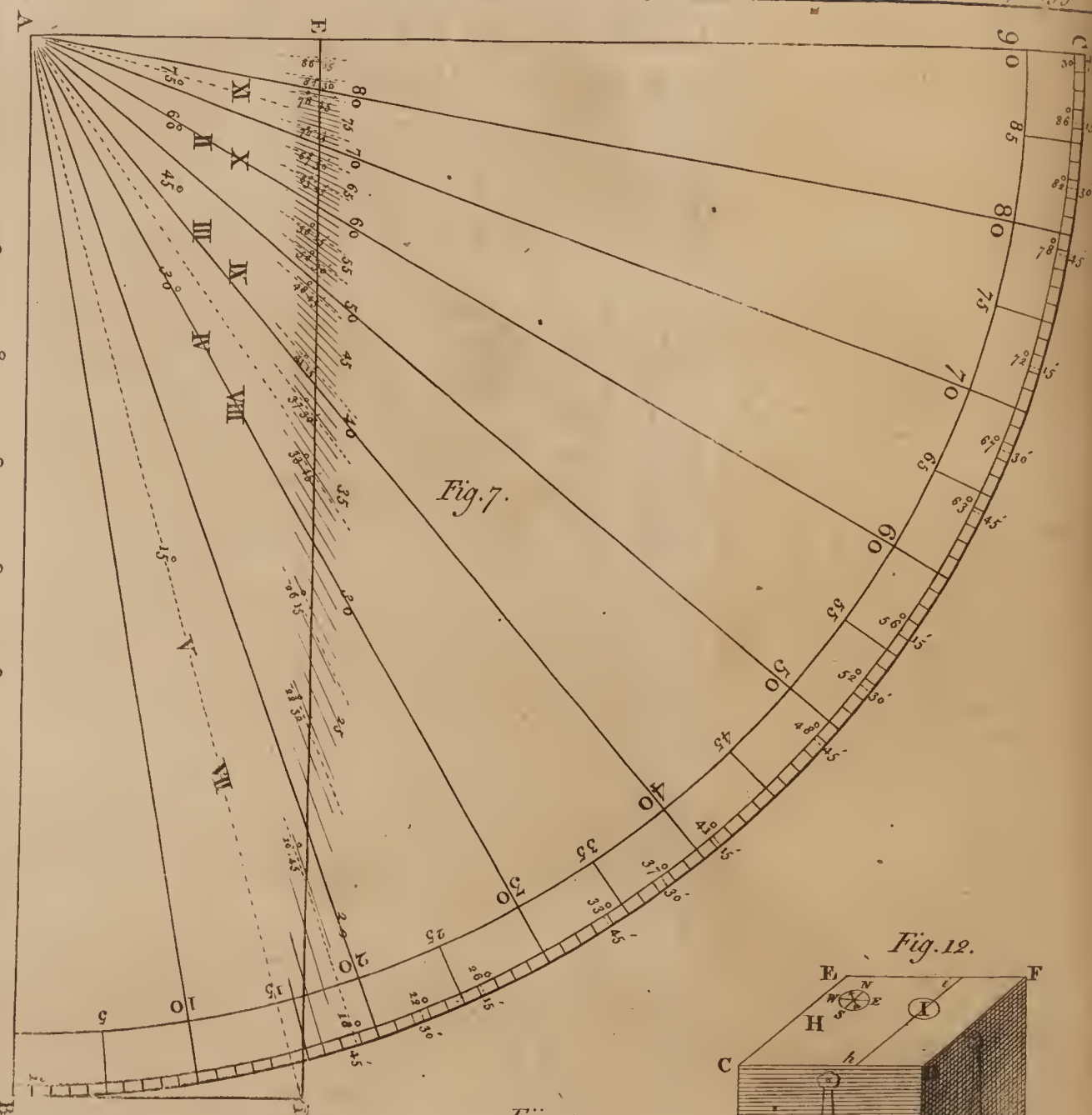
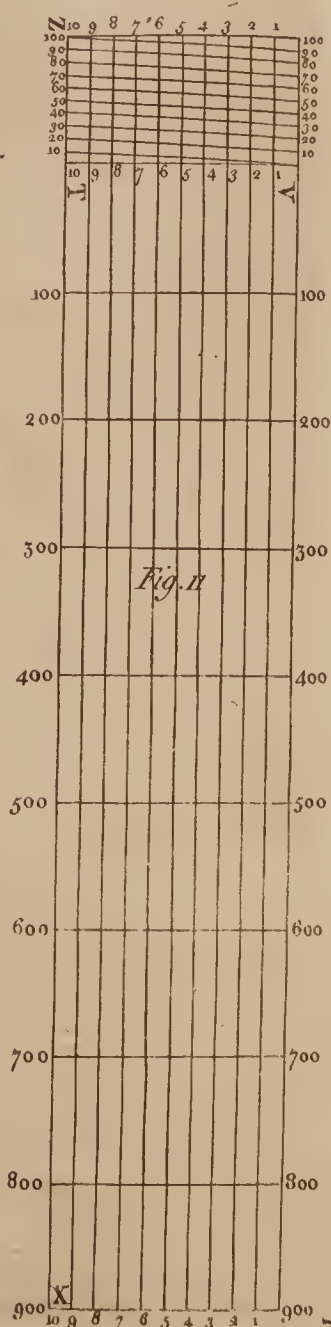
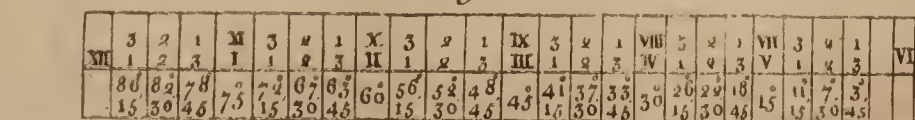
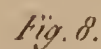
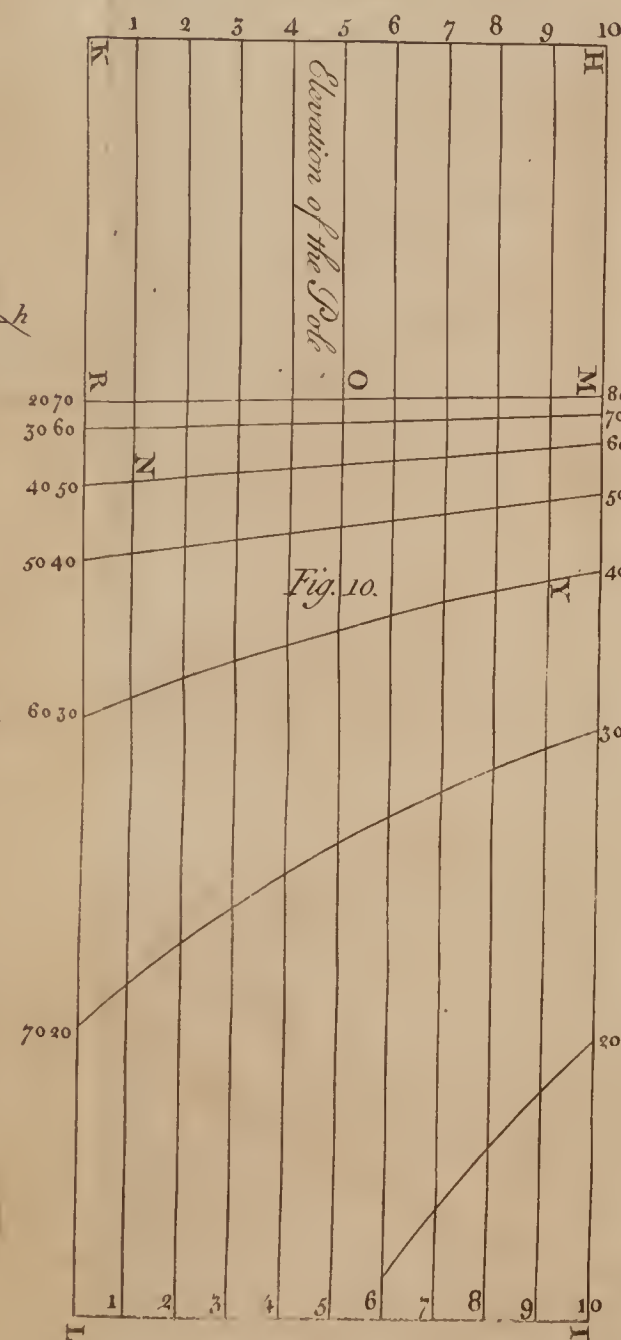
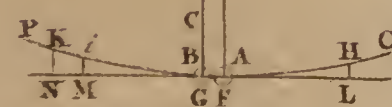
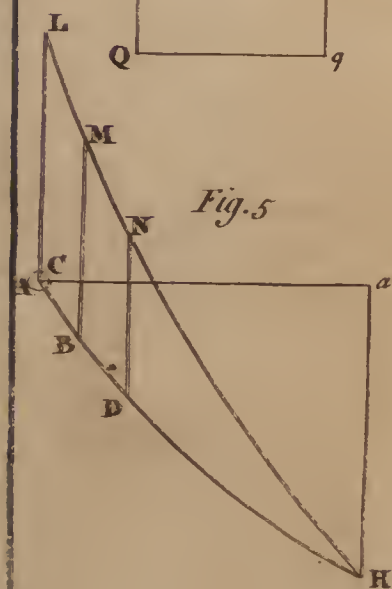
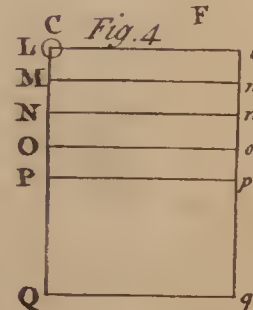
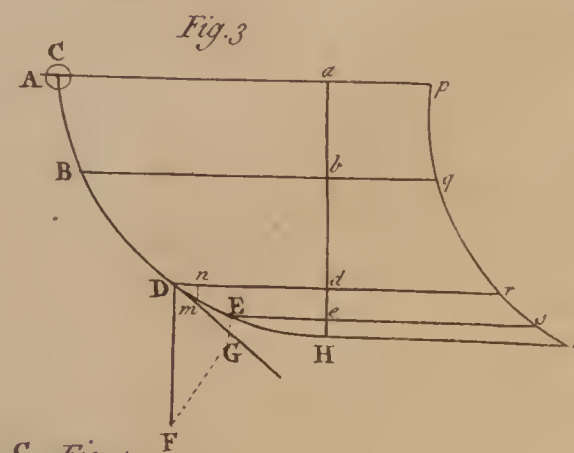
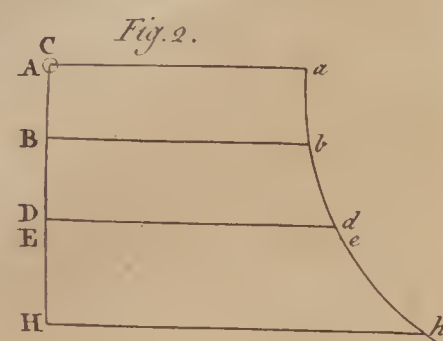
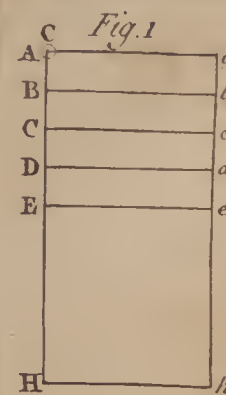
A remedy in a
gangrene.

FROM a sort of malignant measles, which lately raged among us, a girl had her face so marred with a gangrene, that her lips were almost eaten away: I speedily put a stop to this spreading evil by means of sea-water, in which some wormwood was boiled; and this experiment I also repeated in other gangrenes with good success.

Observations.

No one can well doubt of the great variety there is of simple medicines; *Grecce* had its own proper remedies; *Mauritania* supplied a great plenty of them: But as *Rombæus* affirms^a; we still see a great many more in use, of which they knew nothing at all; and with what store of remedies do not both the *Indias* and their adjoining islands furnish us at this day? Yet most people, and that not without reason, judge native remedies preferable to exotic, both on account of their affinity with our natural constitution, as that we in vain look for remedies abroad, of which we have such plenty at home, according

^a Epist. 28. p. 98.



According to *Andr. Libavius*^b. This, especially *Beverovicus*, a physician of *Dort*, was aware of, who publish'd at *Leyden* in 1614 an elegant treatise, entitled, *de Αὐταρχείᾳ Bataviæ S. Introductionem ad Medicinam Indigenam*; in which he shews, that every nation has all its necessaries in abundance, and that consequently each malady has every where its own remedy; and as nature does nothing in vain, nor is deficient in any one thing that is necessary, why should she be thought a lavish parent to the *East* alone, and a froward stepmother to the rest of the world besides? Native remedies, indeed, as to their certainty, efficacy, purity and expense, have a greater suitableness to the constitutions of the inhabitants^c, tho' far-fetched medicines are generally more regarded. *Primerose*^d took upon him the same defence of simple medicines: And *Pliny*^e even in his time, tho' for the most part too violently, has prefer'd native to exotic remedies, when he says: 'Nature design'd such remedies alone, as are commonly and with ease procured from the fruits of the earth; in process of time avarice and imposture set up the craft, wherein the lives of men are exposed to sale, and inexplicable compositions and mixtures cried up', &c. To the same purpose the excellent *Bartholin* had writ a book, entitled *Medicina Danica inquilinis remediis proprios morbos sanans*, but which perish'd in the fire of 1670. He writes of this performance thus in his treatise, *de Incend. Biblioth.* p. 69. 'I inclined to be of service to the meaner sort, and not to the learned, tho' I may expect but little thanks from the apothecaries: For the cure of native diseases God has furnished native medicines, which every one may use without either apothecary, or physician, or great expence: Thus I have cured a palsy of the left side with malt-spirits, in which primeroses were boiled; epidemic pleurifies with a bare decoction of barley; scorbutic patients I have purged with a decoction of water-creffes in old beer, and hydropic patients with the more tender leaves of the elder'.

^b Epist. ad Schnitz. 44. p. 135. in cistâ Hornung. ^c Benerovic. l. a. c. 2. p. 65.
^d Error. in Medic. l. 4. c. 7. ^e L. 24. c. 7. It. L. 22. c. 24.

An instrument for describing all manner of Sun-dials: And another instrument for exactly finding when it is noon. By Leutmann. From the Breslaw Collection, Jan. 1718. Class V. Art. VIII. p. 599.

Translated from the HIGH-DUTCH.

M. *Leutmann* in the first place gives the geometrical, and after that, ^{Fig. 7. Plate VI.} the trigonometrical method: The geometrical construction consists ^{The geometrical construction.} in a quadrant ABC, divided into its 90 degrees, from whose centre A the radii, drawn through all the degrees, intersect the line ED; the line ED is from the point D (where the radius, produced thro' the

Fig. 8.

15th degree, intersects the perpendicular erected from B) drawn parallel to the line A B. On this line E D the radii cut off the proper distances for each hour, which are set off from the hour of XII. at equal distance both before and after noon. The table (fig. 8.) shows how many degrees and minutes the distance of each hour cuts off, and in this table the literal characters, and those standing nearest over the line, represent the hours after noon, and the others the hours before noon: And the numeral characters 3, 2, 1, that stand between, the quarter-hours: The nearest characters under the line and mark'd with (o) show the degrees: The numbers beneath, mark'd with (') the minutes corresponding to each hour. For instance, under XI. stands 75° ; this shows, that the distance between E and where the line, drawn from the centre A through 75° , intersects the line E D, is the distance between XII and XI before noon; and between XII and I after noon. In like manner 78° shows that the distance be-

Fig. 7.

tween E and 78° and $45'$ on the line E D is the distance of $\frac{1}{4}$ of XII and $\frac{3}{4}$ of I from the hour of XII, &c. To understand this the more easily, in fig. 7. the hours are annexed to the degrees, corresponding to them, with literal characters. But that we may also on the line E D have the minutes for the quarter-hours, we have again divided 90 degrees into 4 parts; and set down 1 part thereof to the degrees where 15 minutes, 2 parts where $30'$, and 3 parts where $45'$ are requir'd in the table of fig. 8.

Fig. 8.

But we have represented the parts of the radii, where they intersect E D with dotted lines, and also added the numeral characters; for which purpose the quadrant is to be made pretty large. Upon setting off these distances of the line E D, where the point E is taken for the hour of XII,

Fig. 9.

on the line P Q (fig. 9.) and marking upon it the hours, we thus obtain the proper *gnomonic ruler*: For instance, the distance between E (fig. 7.) and the intersection of the radius at 75° is taken with a pair of compasses and laid off on the line P Q (fig. 9.) namely from the point at the hour of XII till where 12 stands: This is the space between 12 and 11, as also between the hour 12 and 1. The distance between E (fig. 7.) and where the first dotted line $15'$ behind 86° shews the line E D, which is also set off on P Q; and thus we have the distance between 12 and $\frac{3}{4}$ of 12; as also between 12 and $\frac{1}{4}$ of 1 o'clock, &c. as plainly appears from comparing the line P Q (fig. 9.) with the quadrant (fig. 7) and the table (fig. 8.)

Fig. 7.

Fig. 9.

Fig. 7.

Fig. 9. . 7.

Fig. 7.

Fig. 10.

Now as for the delineating of a dial it is not only necessary to have the distance for each hour, but also the elevation of the pole, the distance between the centre A (fig. 7.) and where each degree cuts the line E D, gives the elevation of the pole of each degree; as for instance, the part of the radius drawn thro' 80° from A to the line E D, is the elevation of the pole of 80° . A 75° , the elevation of 75° , &c. But now to obtain this in particular, there is made a parallelogram H I K L (fig. 10.) (the larger

larger it is the better) and its sides HK and LI are divided into 10 equal parts, through which lines are drawn: On which again with a pair of compasses is taken in the quadrant (fig. 7.) the distance A 80° , and set off from H to M (fig. 10.) the distance between A and where 79° touches the line ED in the quadrant is laid off on the second line 9, 9 (fig. 10) A, 78° , on the third line 8, 8, &c. that the distance in the quadrant A, 70° , may fall on the 10th line KL in R, through these points the line MOR is afterwards drawn; and then also this distance A, 70° , is again set off on the first line HI; the distance A, 69° , on the second line 9, 9, and so on through all the degrees: And thus we have compleated the second part of the *gnomonic ruler*, on which we may have the elevation of the pole of each place; as for instance, if we would have the elevation of the pole at *Breslaw*, which is 51° , on the line KL we look for 50, and on the line HK, the line 1, 1; where this last is intersected in N by the transverse line 50, 60, we have from I to N the elevation of the pole of 51° : In like manner SO is the elevation of the pole of 75° , HM for 80° , &c. The fig. shows, that on the outmost lines HI and KL the degrees from 10 to 10 are to be found: And from 70 to 20 on KL; and from 80 to 20 on HI, which is necessary in horizontal dials. In vertical dials the complement to 90 degrees is taken, On this account also the figures, namely to 80, are annexed on HI, 10; to 70, on KL, 20, &c. Now the manner of using these two parts of the *gnomonic ruler* shall be shown below, when we shall have first premis'd the trigonometrical construction of this instrument. To find the distances for the hours on the line ED we need only observe, that the line AE is equal to the line BD, and this is the tangent of the angle of 15° BAD. It also appears from the fig. that E is a right angle. Farther, it is plain, that you may easily obtain the angle, which the radii form with the line EA at the centre A; namely, if you reckon above the degrees on the quadrant between the radius and the line AC, or which is the same thing, the angle at A is always the complement of the angles to 90° , which the radii shew; as for instance, the angle 80° AE is the complement of 80° to 90, namely 10° : Now from these *data*, the distances from E to the intersection of the *radii* may be easily found: And from these *data* also we may have the distances of the *radii* from the centre A to the intersections of the line ED, after subtracting the angle at A from 90° , there remains the angle, which the radii form with the line ED; and thus we always have in the right-angled triangle the known leg AE and the opposite angle, together with the right angle, from which may be easily had, in the usual manner, the hypotenuse; and in this manner the distances for the elevation of the pole may be found. But for the benefit of those, who are not conversant in these matters, but who take a pleasure in drawing dials, we shall here add the following calculated tables.

Fig. 10.

I. *A table for the gnomonic ruler to set off the hours and quarter-hours from the scale.*

Hours <i>a. m. p. m.</i>	Parts	Hours <i>a. m. p. m.</i>	Parts
XII	— —	IX 3	2680
3	176	3	3055
2	353	2	3492
I	538	I	4010
XI I	718	VIII 4	4641
3	909	3	5433
2	1110	2	6469
I	1322	I	7894
X 2	1547	VII 5	10000
3	1790	3	13470
2	2056	2	20350
I	2350	I	40881

II. *A table for laying off the elevation of the pole from the scale.*

Deg.	Parts	Deg.	Parts	Deg.	Parts	Deg.	Parts	Deg.	Parts
10	15430	24	6588	38	4353	52	3401	66	2953
11	14043	25	6340	39	4258	53	3355	67	2911
12	12888	26	6113	40	4168	54	3312	68	2890
13	11911	27	5903	41	4084	55	3271	69	2870
14	11076	28	5707	42	4004	56	3292	70	2851
15	10353	29	5527	43	3929	57	3195	71	2833
16	9721	30	5359	44	3858	58	3160	72	2817
17	9165	31	5202	45	3790	59	3126	73	2802
18	8671	32	5056	46	3726	60	3094	74	2788
19	8231	33	4920	47	3664	61	3064	75	2774
20	7835	34	4792	48	3605	62	3035	76	2762
21	7477	35	4671	49	3549	63	3007	77	2750
22	7153	36	4559	50	3497	64	2981	78	2739
23	6858	37	4453	51	3448	65	2956	79	2730
								80	2722

Explanation.
Pl. VI. Fig. II.

In using these tables there is nothing other requisite than a scale (as represented fig. 11.) the construction of which may be easily learn'd from *Sturmius' Mathesis juvenilis*^a, or any other elements of geometry. We have divided

^a Tom. I. Geometr. Sect. I. Art. I. qu. VII. p. m. 204.

PLATE VI.

Tab. 1.

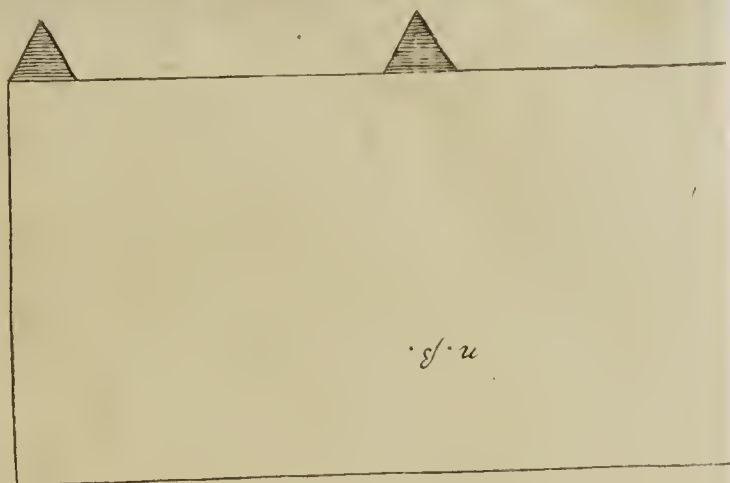
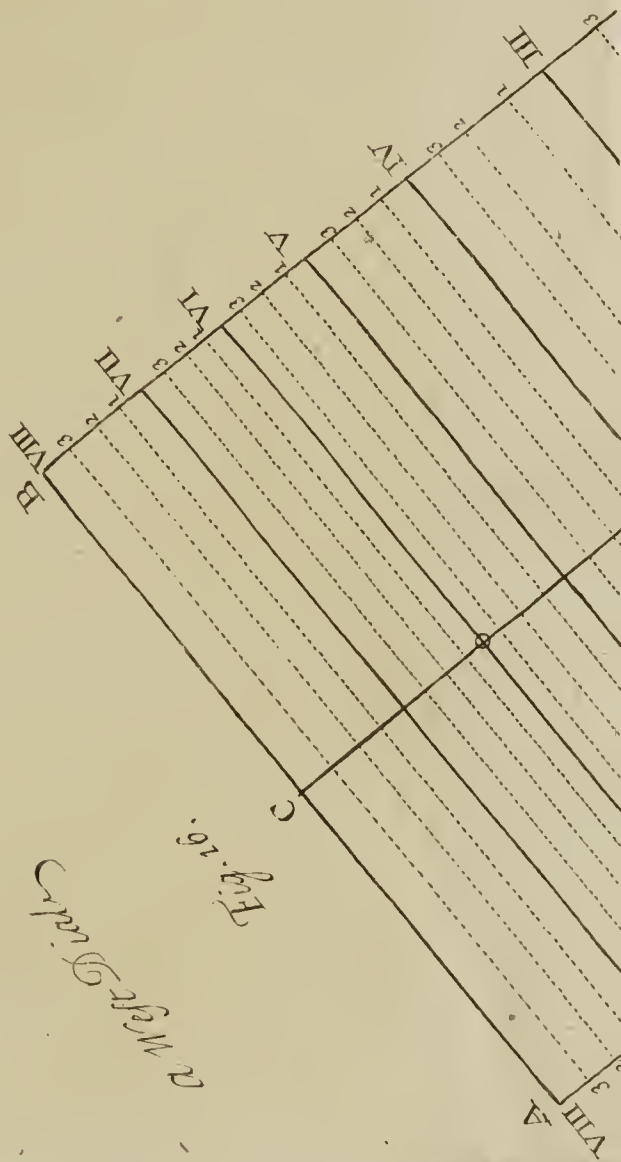
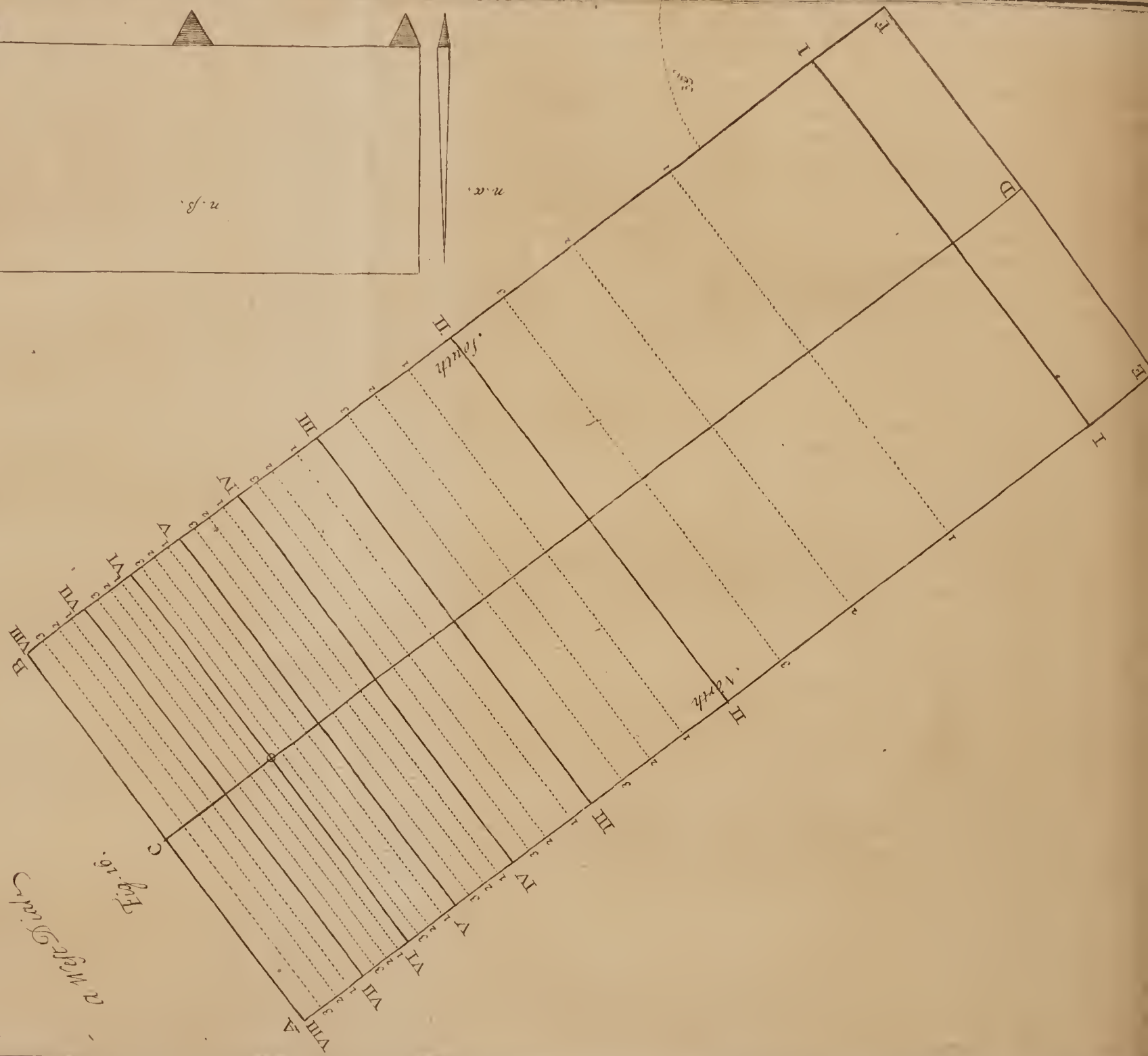
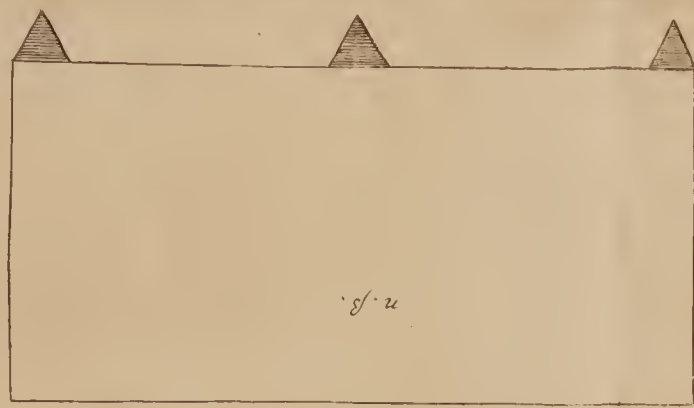


PLATE VI.

Page 444.



divided the radius of the quadrant into 10000 parts, that the coincidence of these tables with the quadrant may be perceiv'd. In other respects the thing may be perform'd according to any scale. The use of these tables entirely coincides with the quadrant; and in the following manner the hours may be delineated; draw the line AB (fig. 14.) in the middle from the point D erect the perpendicular DC; the use of tab. II. is to determine the length of this line DC, as it represents the elevation of the pole in a horizontal dial, such as this is design'd to be; as suppose we were to make a horizontal dial for the meridian of *Breslaw*, look for the elevation of the pole at *Breslaw*, namely 51° , in the column of degrees; just opposite thereto is found the number 3448 in the column of parts; and so many parts are to be taken from the scale (fig. 11.) and set off on this line CD. But as this scale is only divided into 1000 parts, but in the table the parts are reckon'd to 10000, the last figures, if below 5, may be omitted; but if above 5, the last but one may be increas'd with 1. And thus here instead of 3448, we take 345. In this manner one leg of the compasses is set in the cross line of the scale, where 300 stand; and the other leg is open'd to 40 on the line AB; and then both the legs of the compasses are advanced to the line where 5 stands above between AZ, and under BX; and thus it takes in the distance of the cross line 300 till where the diagonal 40 cuts the line 5; and thus you have 345 parts for the length of the line CD, the point D gives the hour of XII: To set off the remaining hours, the first table is made use of; for, in it we find in the first column the hours before and after noon; the former of which are mark'd with literal characters, but the latter with numeral characters; and in like manner the quarter-hours. But in the adjoining column the parts for each hour are to be taken from the scale (fig. 11.) namely for XI and I, 72, after that as was mention'd in the first table, the last figures are omitted; and the last but one is increas'd, when it exceeds 5, as in this case: Hence one leg of the compasses is set on the line TV, as the number is not 100, where the line 2 intersects it; and the other leg till where this line intersects the diagonal drawn from 70 to 80; this distance is set off from D on the line AB on both sides in XI and I: In like manner for X and XI, 155 parts (instead of 1547) are set off from D on the line AB from the scale, when the compasses are set with one foot on the cross line 100, where the line drawn from 5 to 5 intersects it; and afterwards to where this line cuts the diagonal drawn from 50 to 60. And thus you proceed till the hour of VII and V; for the hour of VI through the point C is drawn a parallel to AB, which is obtain'd, when from the points of VIII and IV or IX and III perpendiculars are erected; and on it is laid off the height DC, and thro' the points a line is drawn. And for the quarter-hours you proceed in the same manner, as with the whole hours; and they are all laid off from the point

Fig. 14.

Fig. 11.

Fig. 11.

Fig. 15.

he shows, that he caus'd make for horizontal and vertical dials a right angl'd triangle (as was shown fig. 15.) of firm wood; or which is still better, of stone, and compleats only half the dials, on which he accurately fits the triangle, which he makes three fingers broad with one edge accurately applied to the line of the hour of 12, and makes it very fast: And on the other edge of the triangle he draws the 12 hour-line, and from it sets off the remaining hours; and the thickness of the stile is no hinderance, provided the sides be made very sharp: And one edge of the upper sides shows the forenoon hours, but the other the afternoon hours entirely accurate, as may in some measure be seen from fig. 18.

Fig. 18.

An instrument
for exactly find-
ing when it is
noon.

Fig. 12 13.

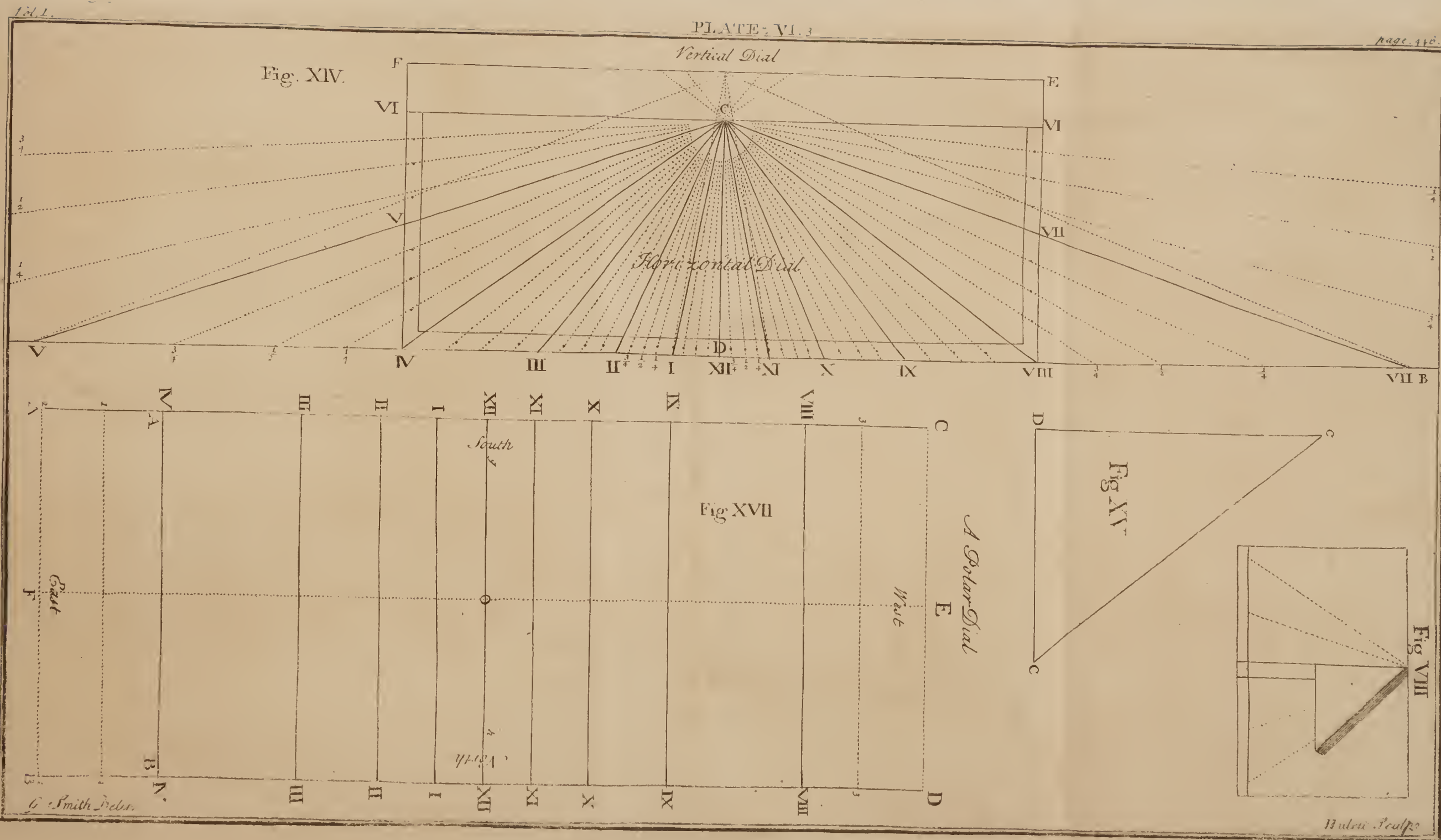
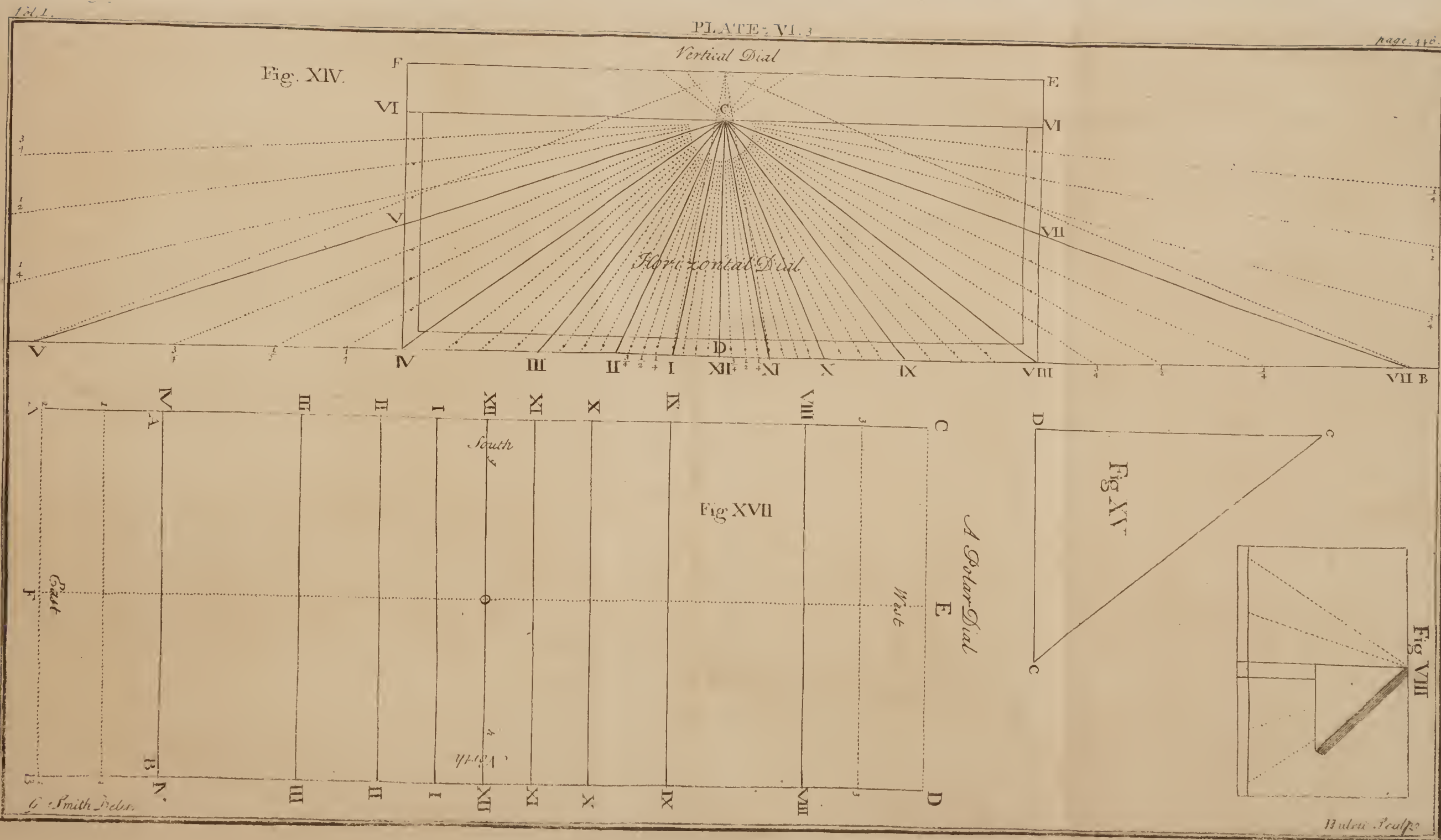
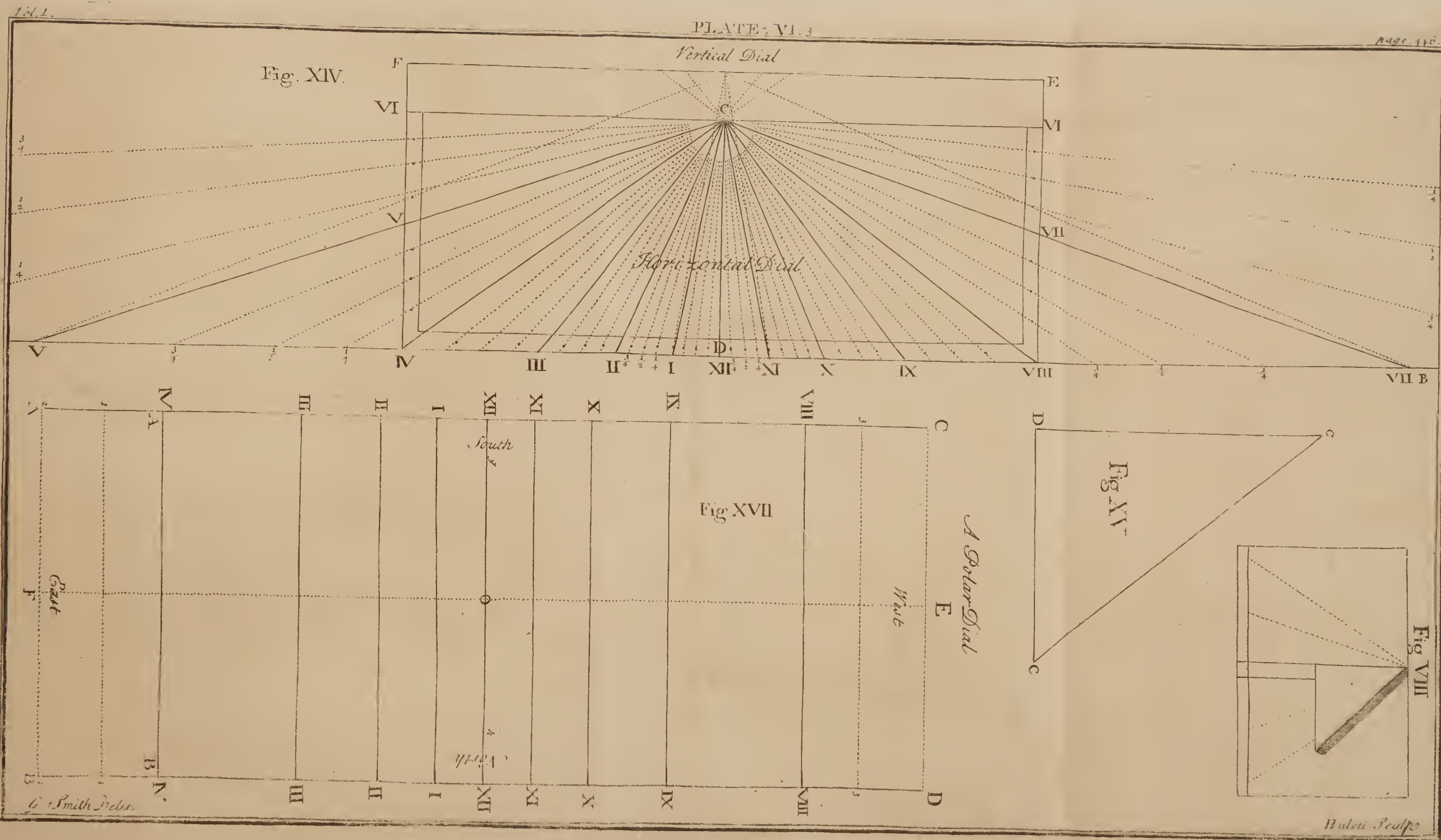
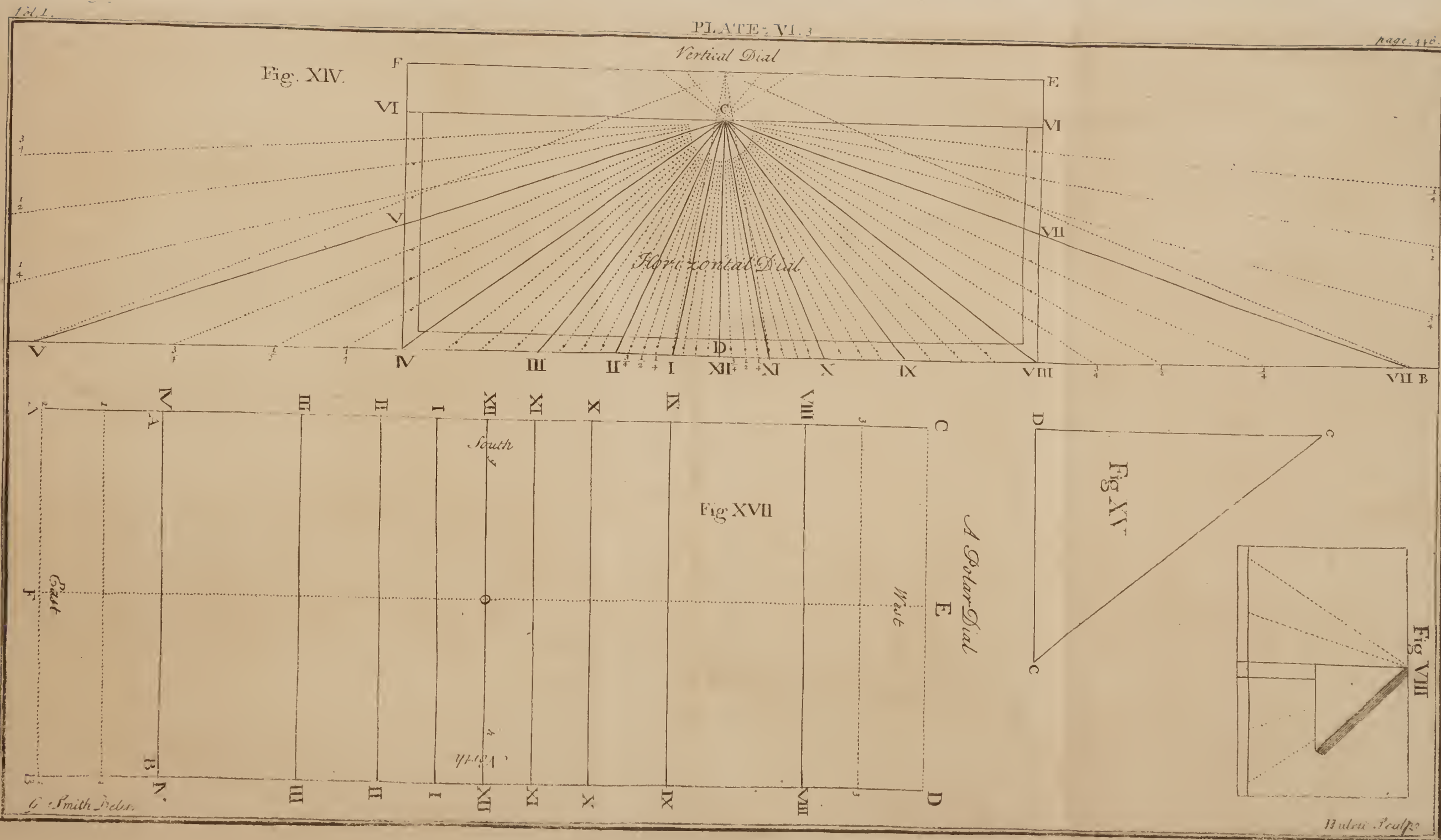
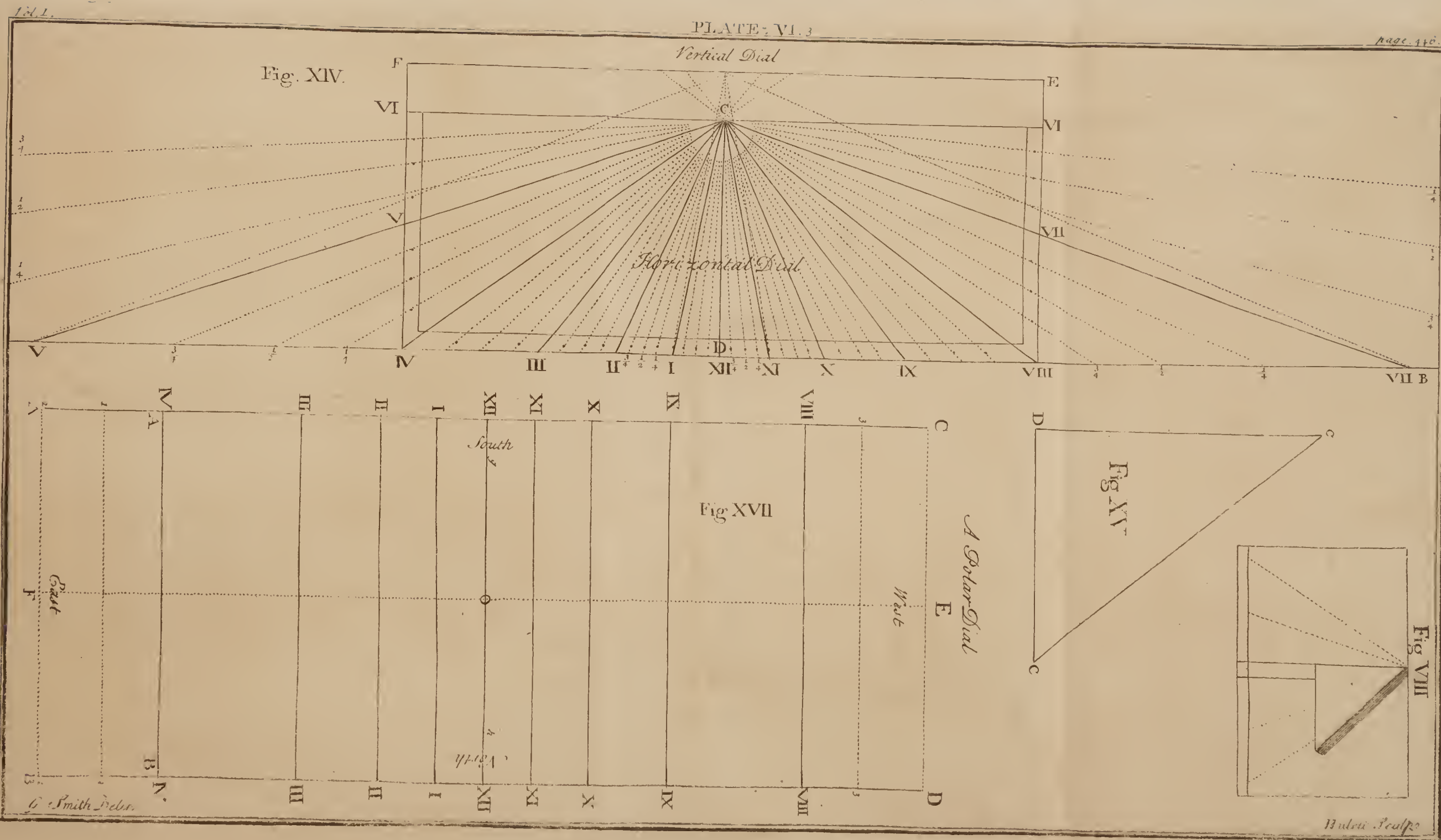
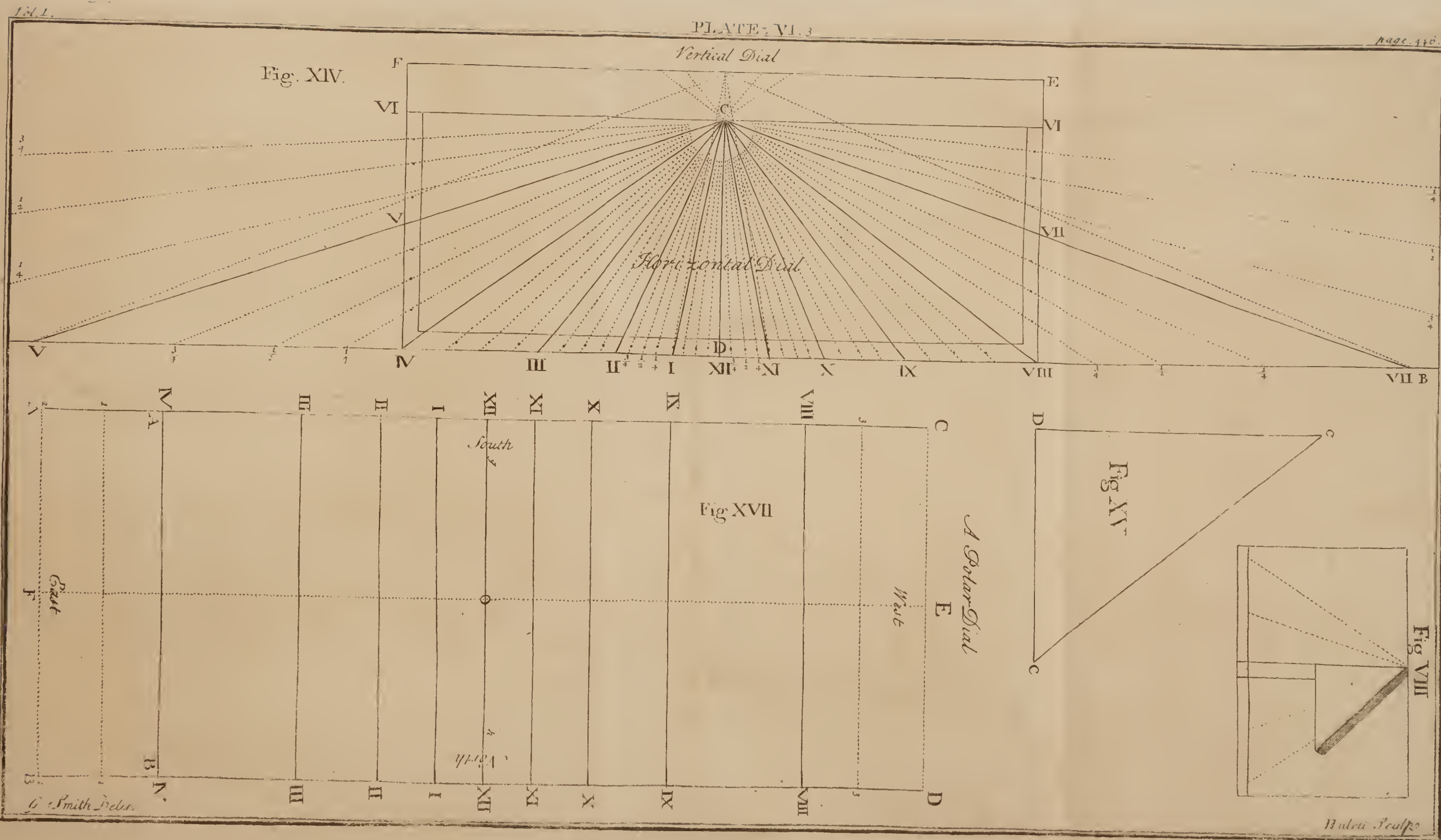
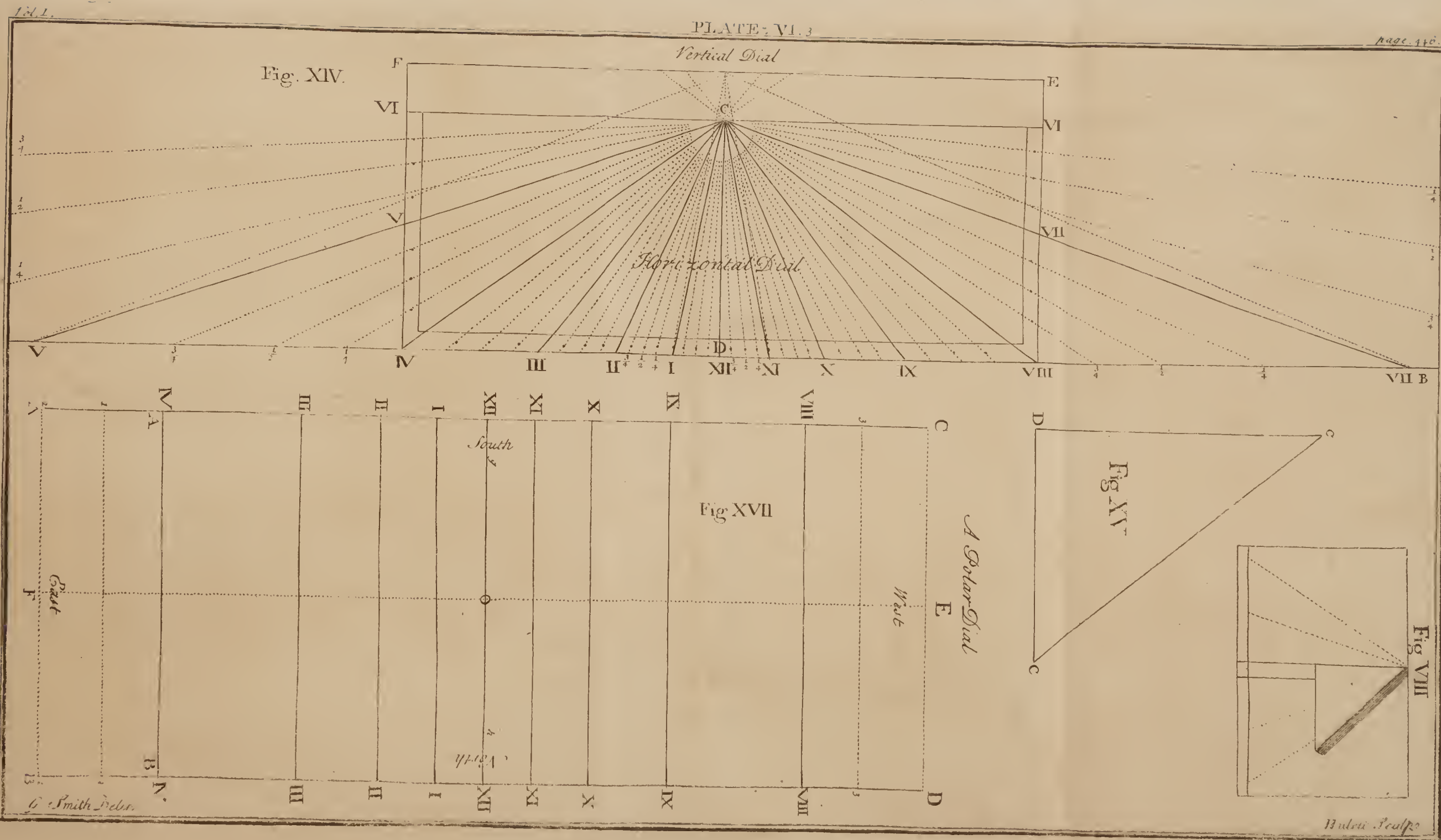
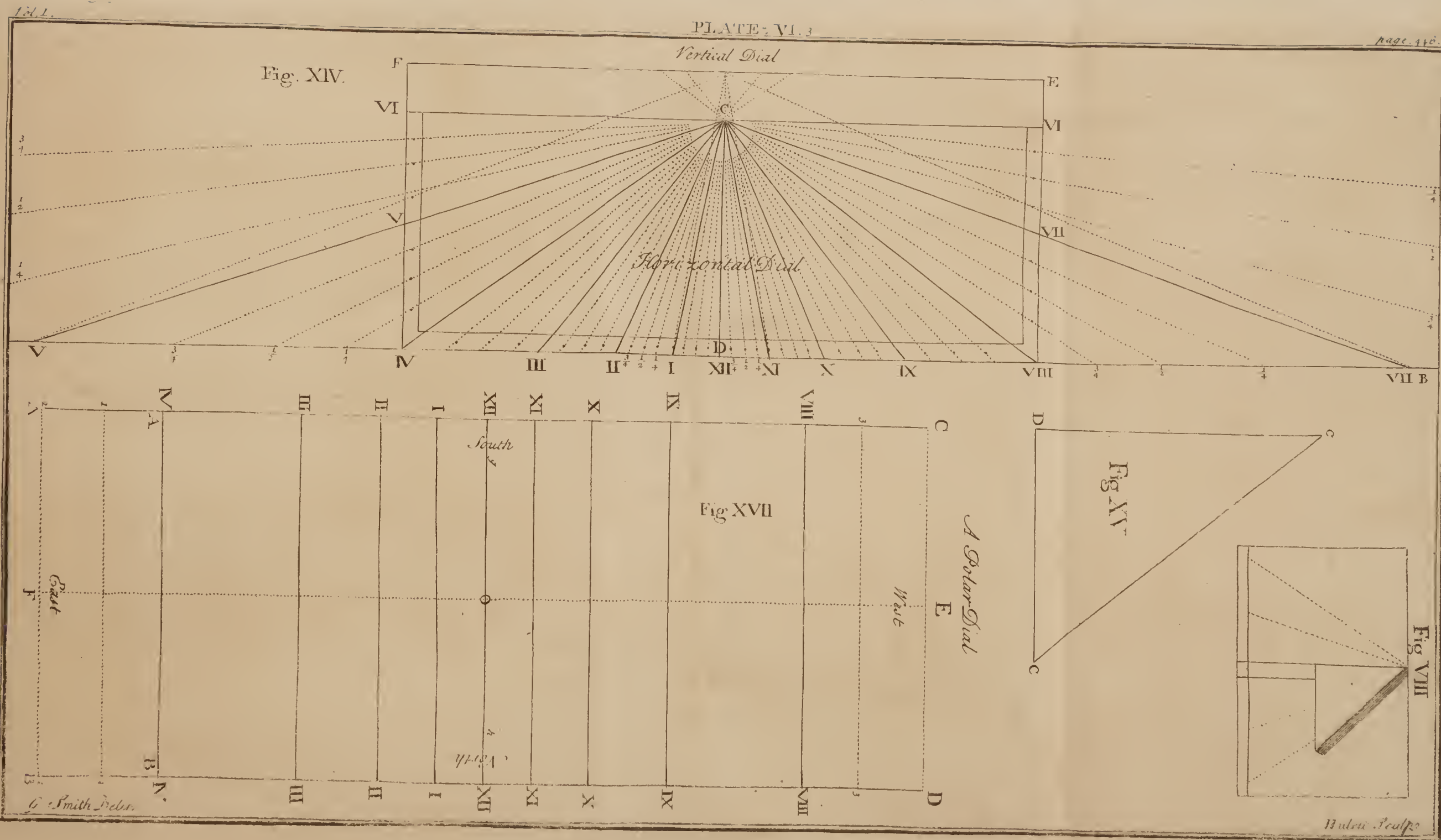
As to the instrument, by which it may be exactly discover'd when it is noon, it is hop'd it may be acceptable to such as carry watches; as by its means they may be accurately set, which cannot so well be done at the rising or setting of the sun. The instrument is represented fig. 12 and 13. It consists of a hollow cube, made of wood or brass, on which above is fitted a compass at H, that it may be rightly set. At C is a circle, thro' whose centre a line *bi* is drawn, at an equal distance from the side D F, forwards and on the sides are fasten'd plummets (as the fig. shows) that play easily and justly, by means of which when they stand exactly in X, or at 90°, the instrument may be set exactly horizontal. In fine, there is turn'd a brass or wooden cone (fig. 13.) whose base K is as big, as the circle I, about an inch in diameter; when the needle points exactly north, and the plummets stand accurately pois'd, the cone is set on the circle I: And as soon as the shadow of the point of the cone falls on the line *bi*, it is noon; and the watch may be set to 12.

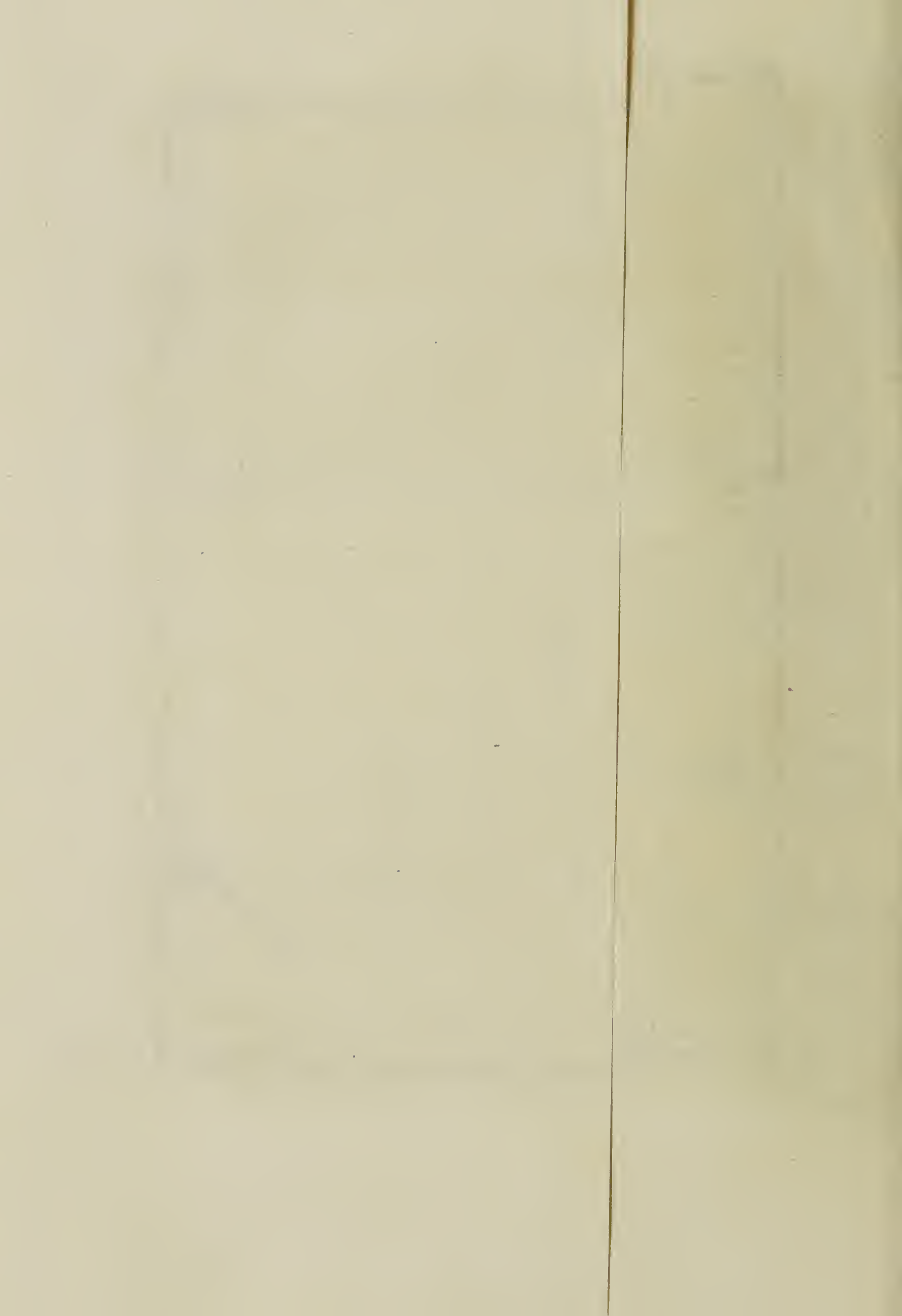
An Observation on the Method of preserving Anatomical Preparations in Liquors. By Christoph. Jac. Trew. *From the Commercium Literarium Norimbergense.* An. 1731. Specimen IX. p. 68.

Translated from the LATIN.

Requisites in li-
quors for preserv-
ing anatomical
preparations.

SUCH apply themselves very usefully to the business of anatomy, as are employ'd in preserving the better or the more rare preparations therein, that upon any occasion, they may be show'd and view'd: And for this purpose almost every one has his own peculiar liquor, and which he generally keeps as a secret. But to the goodness of such a liquor the three following conditions especially are requisite. 1. That it preserve the preparation from corrupting and drying. 2. That it cause no change in the natural colour of the preparation. 3. That it be not too volatile; and that it stand not in need of fresh repeated supplies. Such liquors are generally prepar'd in the following manner; to three drachms of





of choice amber, one drachm and a half of camphire, and one ounce and an half of *Venice* turpentine, are put 2 lb. and a half of spirit of wine: After digesting for some days, let the distillation be perform'd from a sand-heat; or to white amber, put into a glass-cucurbite, pour as much rectified spirit of wine, as to rise above it two fingers breadth; after digestion, let the distillation be made from a sand-heat: And to each pound of spirit thus abstracted add of camphire and *sal ammoniac* two drachms each; and keep for use the spirit drawn off by a fresh distillation; for, experience has sufficiently taught me, that the balsamic liquor, prepar'd both ways, is as volatile as bare spirit of wine; but that, besides, it has this disadvantage with it, *viz.* in a short time it contracts a remarkable yellowness, with which it also tinges the preparations. And I am also well assur'd, that bare pure spirit of wine, highly dephlegm'd and limpid like the purest water, does in a short time turn yellow; and that it turns the more so, if impregnated with oleous and resinous particles: But this happens not to malt spirits. Wherefore, for many years back I am us'd to employ plain malt-spirits well dephlegm'd for preserving my preparations; with this advantage, that such as I put into it, are conserv'd to my mind, and not tinged with any foreign colour whatever; besides, it may be procur'd at a far less expence.

But I shall briefly explain in what manner I obviate the disadvantages of a too great volatility. I cover the mouth of the glass with a round glass-plate, exactly fitted to its bigness; I lay on a double moisten'd bladder; and this I moreover cover with foils of tin: And all these I secure with proper threads, closely tied round, being well assur'd, that the spirit, which yet successively diminishes by exhalation, rather escapes thro' the pores of the glass than the above covers. What is an argument with me is, that I have often observ'd, that round glass-plates, laid on in the manner mentioned, in such glasses where a great deal had exhal'd, do by the pressure of the incumbent air burst into several pieces, and that with a great noise, which I think could not have happen'd, had the spirit escap'd thro' any chink left open, as I see not what should hinder the air from entering thro' the same passages and filling up the empty space.

Their too great volatility how obviated.

If there are any preparations that we would fain have to hang freely in the spirit, I usually tie them with a white horse-hair, and then I fit two pieces of wood, laid a-cross, in such manner to the mouth of the glass, that the hair may be fasten'd to them; and yet so that neither the glass-plate may touch the pieces of wood, nor be hinder'd by them from closely covering it.

Preparations how made to hang freely in the spirit.

But if there are some preparations, which we foresee are to be often taken out and shewn, or larger than that we can find glasses capacious enough for keeping them; for preserving such some prefer liquors saturated with salts; as for instance, they dissolve alum in simple water, as much.

Saline liquors and their disadvantages.

much as the water will take ; then add common salt ; and if they will, nitre as much as it will receive ; or they dissolve *sal ammoniac* and quick-lime in water ; and after filtration the clear liquor is employ'd. But saline liquors have especially this disadvantage, that the preparations do not sink but float in them. Wherefore, they must be depress'd by some weight and kept plunged. Besides, salts easily shoot into crystals and adhere to the preparations, especially if the vessels be not often mov'd, and water carefully pour'd off for their solution.

Preparations how to be treated before they are put into the conserving liquors.

Of all preparations, if we incline to keep them neat, we are to hold, that before they are put into the conserving liquor, they ought for a pretty long time to soak in pure water, which is to be renew'd every day, till it extract no more redness ; and then if you incline to put them into a spirit (for, there is no occasion for this in a saline liquor) pouring on for some time malt-spirits, both the aqueous humidity and any remaining blood are extracted : And this you should continue to do, till you are well assur'd, there remains nothing therein, which may either weaken or pollute the purest spirit.

Several Experiments. By Olaus Borrichius. From the Acta Hafnienfis. An. 1671, 1672. Obs. LXII, &c. p. 138. seqq.

Translated from the LATIN.

Water continuing without boiling in the heart of boiling water. Obs. 62. p. 138.

THE following experiment may possibly serve to clear up the nature of fire. As often as a liquid is heated by a solid, the heat is propagated thro' all the body of the liquid, by means of bubbles arising from the bottom of the vessel especially, and at length collecting themselves in great numbers on the surface ; hence that scum which widely overspreads the face of the liquor. This appears very evidently in glasses fill'd with water, and laid on the hot furnace of a copper : Besides, if the heat proceeds from a liquid and soft heating body, the bubbles arise so sparingly, that tho' the water within the glass, suspended in the hot liquor, be greatly heated ; yet I could by no means hitherto bring it to boil. This I often experience in water ; namely I suspend a narrow-mouth'd glass half full of water in the heart of an iron-pot fill'd with water too, and setting a fire under, both the waters heat, but while the external water very strongly boils, that in the glass continues calm without boiling at all ; and I often take out the glass-vessel from that frothy water, and view it without any apprehension of its cracking, and again put it in ; and no trace of any bubbles is seen on its surface, tho' the boiling liquor in the pot almost sheds over the brim. I own, that some bubbles also arise from the bottom

bottom of the glass; but these very few in number; and which all vanish before they can reach the surface. It is probable, that if another glass were included in the former, it would happen, that not so much as one single bubble would appear in the liquor contain'd therein; for, the bubbles observed in the first glass do almost all of them fall back again; and the same thing would happen the more certainly in the 2d glass. This experiment was, probably, not unknown to such as first devis'd distillation by a *balneum Mariæ*, in which every thing obtained in this manner is milder for medicinal use and causes less disorder in the body than those procured either by a sand-heat or by the hurry of a naked fire.

There are who imagine I know not what frigorific atoms deriv'd from the *hyades* to the earth, which in winter insinuate into water, and by their accession form that liquor into a solid mass; a conceit rather more ingeniously devis'd than agreeable to nature, as I think I have discover'd in the following manner. In a very severe winter I took a narrow-mouth'd, but bellied, glass; and putting into it 5 lb. of common water, I clos'd it with three folds of bladder previously moisten'd with oil, lest any thing foreign should insinuate into it; I then accurately mark'd a line with a diamond on the place, where the water, still liquid, stood in the vessel. In this manner I set the glass on the flat roof of my house; and after half a quarter of an hour it show'd some uncommon commotion within, accompanied with a remarkable noise. I quickly view'd it and I observ'd almost in a moment all of the water, the glass continuing entire, converted into ice; and that the ice rose almost two inches above the line mark'd by the diamond. I began to think, that some foreign substance had, probably, with that noise enter'd the glass; but both the empty spaces up and down in the ice, and the weight remaining unchang'd, soon show'd the contrary; for, the weight of the glass, after the water was frozen, was the same as before; so that it might justly be concluded, there was no new accession of matter to it, but that the matter of the first element, putting the parts in commotion, and being scarce of any sensible weight in so small a quantity of liquor, had however retir'd, these particles being otherways somewhat dispos'd for such a retreat; nor afterwards by the fire was there any thing observ'd in that ice than what we observe in common water: Whence, probably, one may give in to this opinion, namely, that all water when left to itself always congeals; but that in most places it is kept agitated in a certain violent state by the astral rays and subterraneous fires, and that for the conveniences of men and fishes; for, we observe it, when less disturb'd and less mov'd by external causes, as in most ridges of the *Alps*, *Pyrenees* and *Norwegian* rocks, always to remain either ice or a snow emulating ice; and this I have observ'd on the maritime *Alps*, on the *Alpes Cottiae*, which part *Dauphine* from *Piedmont*, at the magnificent monastery of the *Carthusians*, in the valley *Pragelas* and in other parts in the extreme hot months of *July* and

Congel'd water receives nothing foreign into itself, neither increases nor decreases in weight. Obs. 64. p. 140.

and *August*: And when I liv'd at *Turin*, the illustrious Marquis *di Pianezza*, Prime Minister to the Duke of *Savoy*, carried me up to the upper part of that Prince's palace, from whence there was a wide prospect of the *Alps*, and he show'd me a mountain, the *Vesulus* of *Virgil*^a, now the *Monteviso*, from whence the *Po* arises. ' On the lower brow of this mountain, says
 ' the marquis (for, it has two brows or points) is seen a pretty large lake,
 ' which even in the middle of summer is so cover'd with ice, that *Torrini*,
 ' first physician to the Duke, did in the middle of *July* advance 25 paces
 ' thereon; on the south side there was then no snow, but a great deal on
 ' the north; upon cutting the snow he observ'd it to consist, as it were,
 ' of numerous crusts; for, it is probable, that each year a new crust of
 ' fresh snow is added. But the *Roche de Limon*, as it is call'd, is much
 ' higher than the *Vesulus*, and it, in my opinion, is the highest of all the
 ' mountains in *Europe*; on its top the cold is so intollerable, that no one
 ' has hitherto been able to bear it. Prince *Charles Emanuel II.* some years
 ' ago attempted to ascend it on the 24th of *August*; but without accom-
 ' plishing it, he was obliged to come down all shuddering with cold. I
 ' myself sometimes in the advanced summer went up *St. Bernard's* moun-
 ' tain; and there entering into a monastery, which rises amidst heaps of
 ' snow, I have observ'd the water frozen in the very chappel; and the
 ' Religious had each of them their portion of reddish ice given them at
 ' dinner, which they drank after melting it at the fire and receiving it in
 ' a vessel: *Must* carried thither continues still *must* all the year round, and
 ' never changes to vinegar. Common *aquavite* is often condens'd into a
 ' mass resembling soap.'

I have been the larger in this quotation, that it might appear, that water, if left to itself, and free from the disturbing particles of heat, always inclines to a state of rest and to become ice; and it is no obstacle, that only a crust of ice was observ'd in the *Vesulus*, while the remaining liquor continued moveable; for, as there is not there a perfect degree of rest, and as the subterraneous heat of the mountain ceases not to agitate the nearer particles of the water, it is no wonder, that the deeper parts of that lake still remain liquid. These things I adduce to relieve the reader, and not to obtrude them upon him. But to return: On another occasion I committed some ounces of water to a glass-phial, which I hermetically seal'd, and setting it out in the open air, all the water turn'd to ice, the glass continuing entire; no accession of weight was observ'd, tho' by the eye the liquor seem'd to increase in bulk; but that is to be ascrib'd to the empty spaces of the ice: However, it was observ'd, that the ice in the middle of the glass heav'd into an eminence, and was smoother in the other parts. I would here willingly learn, why some vessels burst with the cold, and others that are weaker continue sometimes entire. I remember, that the

^a *Æneid*. X. v. 708.

winter of 1664 was so severe at *Paris*, that a tin-vessel, standing almost full of water on my table, was crack'd in three different places by the night-cold. On the contrary, in the month of *February* An. 1658 at *Copenhagen* in the keenest frost in the memory of man, I have often kept glass-bottles with long necks, which together with the water weighed 3 *lb.* and upwards, close stopp'd in the open air, till all the water was froze; and I observ'd no crack, tho' those that were frozen within doors often burst. I could not hitherto hit on the reason of it; unless, according to the ancient manner of philosophizing, we suppose the cold in the open air on all hands equally to press the vessel, and consequently, cause no crack; but within doors all these circumstances are different; because one part standing near the window or the wall receives a greater degree of cold, another part nearer a desk, or floor, or stove, a less degree: Whence they easily burst. Or, if you will, you may suppose, that the particles of the agitating heat, receding by the approach of the winter chill, do in the open air recede with an equal force and *impetus*; but in a house, for the reasons alledged, with an unequal force. But because my view here is principally to chemistry, I shall add what I have often observ'd; namely, that salt of tartar and any other *alkali* in the intensest degree of cold resolves no less into an oil or liquor on a glass plate than in the middle of summer: And then, that not only spirit of vinegar and the more sluggish spirit of sulphur, but the weaker liquor of salt of tartar, congeal; and that such ice is entirely insipid, no otherways than we yearly experience, that the ice of our seas, even a whole foot thick, is very insipid, if you except its lower surface, which still the salt water washes; and which if you wash off in the slightest manner, the whole mass of ice is insipid to the taste.

Take eight ounces of generous *aqua fortis*, to which add two ounces of camphire well ground, and mixing them give a gentle sand-heat in a glass-phial, till the camphire, dissolv'd into an oil, floats upon the *aqua fortis*, like oil-olive. Let this oil, after the gentle heat of half an hour, by gently inclining the glass, be pour'd off into another glass-vessel, without any the least mixture of the *aqua fortis*; take now, therefore, one ounce of this oil of camphire, and add to it two drachms of purified and laminated silver; boil it for a quarter of an hour with a gentle ash-heat; and the silver will be evidently dissolv'd into a clear liquor. The same thing happens to mercury, two drachms of which do readily relent into a clear liquor in one ounce of oil of camphire. But however undoubted it may be, that camphire does not of itself principally effect this, but by receiving into itself the saline particles of the *aqua fortis*: Yet there are two things, pretty curious, observable here; one, that salts to produce the same effect equally move in oil, as in water; the other, that metals mix'd here with a little of a *menstruum* stand dissolv'd apart and at the bottom of the vessel; and that the rest of the *menstruum* floats above them, distinguishable even

To dissolve silver and mercury by a vegetable sulphur into a liquor. Obs. 65. p. 145.

by the colour and, as it were, by a fine line, from the dissolv'd silver and mercury, a thing hitherto unknown of *aqua fortis*.

An uncommon
dissolution of
gold.
Obs. 66. p. 146.

It is a thing well known to Chemists, that silver is dissolv'd by *aqua fortis*, as also by spirit of nitre; but that gold remains therein entire and untouch'd, and that there is no liquor fit to dissolve the latter without the addition of common salt or *sal ammoniac*; yet I have found, that gold also yields to *aqua fortis*, and is entirely dissolv'd by it, if by two distillations it be previously forced off from an equal portion of nitre; to which degree the *aqua fortis* being advanced by means of nitre, it no longer can dissolve silver, but yet tears it and throws it down a white powder; but very easily it dissolves gold, changing it into a yellowish water. The case is this, in nitre there are saline, volatile and more fix'd parts; in common *aqua fortis* the volatile parts exert themselves; in *aqua fortis* repeatedly distill'd from nitre, the fix'd parts do also discover themselves, and attempt a solution of a new kind. Upon this I bethought myself to try, whether spirit of nitre, distill'd from nitre, would also dissolve gold; but it did not answer. So that, probably, the cause of so great a diversity is to be sought for in vitriol; or we are to suppose, that *aqua fortis*, as being more violent, enters deeper into the fix'd parts of nitre, and carries off some of them (that produce a new operation) along with itself through the still; a thing which happens not to spirit of nitre, unless, probably, the distillation be oftner repeated.

In purified mer-
cury there lies
conceal'd some-
thing acid or sa-
line.
Obs. 67. p. 147.

The nature of mercury may not only strike the vulgar, but even the learned themselves with surprize: Tho' it be very soft and open, as to appearance, yet no metal is found closer than it. Gold does in some measure suffer itself to be divided into parts of a different nature; silver more easily; but there has no one or scarce any been found who has divided mercury: Yet that there are different parts therein I think I have discover'd by the following experiment; I took some very clear plates of steel, and putting them into a new oblong glass, wherein well defecated mercury was kept, I left them plunged therein for three months, without applying any other heat than that of the sun: Afterwards upon opening the vessel, which had been stopp'd very close, I found all my plates cover'd over with rust, tho' kept in the heart of so noble a liquor: Whence I was persuaded, that something acid or saline, the cause of this rust, was inherent in mercury; all of which might at length be, probably, extracted by repeating the same experiment with other different plates. The subtle *Geber*^b acknowledges two superfluous things in mercury; namely, an earthy dreg and a fugitive aqueous dreg: And if this be that watery dreg, let others look to it, how they may purge it of its earthy dreg: While I labour to discover how mercury, which is proper to be employ'd in the worms, may be distinguish'd; for, it is often adulterated, sometimes with

^b Summ. perfect. II. Part. I. c. 4.

lead and again with tin, sometimes with bismuth and at other times with zink, and that not without the detriment of such as use it: And in this case it is not sufficient to strain mercury thro' leather, or to distill it; for, if the adulteration be more artfully made, somewhat of the mixture passes along with it, as was long ago observ'd by *Schroeder*; and by distillation, the whole mixture does oftentimes pass not in a fume, but by fits; and renders the operation doubtful. To determine, therefore, the matter with more certainty, put one grain of the suspected mercury on a burning coal and give it a gentle blast. If all of it go quietly off in fume, it is genuine mercury: If it make a noise upon the coal and attempt its flight by repeated skippings, you are to reckon it adulterate.

But we shall treat more at large of amalgams. And long ago *Vitruvius*^c, Diversity of amalgams. and *Pliny*^d (nor were they, probably, the first) have describ'd the union of gold and mercury; and others, following their example, have prosecuted the same thing in silver. Neither amalgam makes a noise in the fire, by reason of the absence of the impure and noisy sulphur. Lead and tin are easily united with mercury: But their amalgams upon approaching the fire make a violent noise, as charg'd with an useless and fugitive sulphur. Brass too becomes into an amalgam and makes a noise. Antimony mixes not with mercury, nay, not its *regulus*, on account of its copious sulphureous dregs. Of iron and copper *Geber* thus speaks; 'mercury, *says he*, adheres not to iron, unless by the most subtile *encheiresis*; nor to copper, on account of the paucity of quicksilver in their commixture.' Yet I shall show how it may adhere to iron: Take iron-filings, and pour thereto either *Hungarian* vitriol, or other vitriol of copper, dissolv'd in common water; and shaking the vessel up and down, you will immediately observe all the filings cover'd, as it were, with brass-plates; upon observing which pour thrice the quantity of mercury, or better; shake it up and down, and you will observe produced almost in a moment a gross, firm and apparent very good amalgam; but to speak the truth, it is but a superficial amalgam; for, neither are these two bodies united *per minima*: Whence by frequent triture in a stone-mortar, the union is again dissolv'd: Yet brass is easily, but in a somewhat longer time reduced to a genuine amalgam; and that it is such appears from its pliability, which is one argument of the most perfect amalgam. A fresh-made amalgam of copper makes some noise on burning coals, because of the more impure sulphur it holds, but yet sparingly; and none at all, if it be for any time expos'd in a warm place: Nor, even did it make the most violent noise, would it affect the former experiment; as this kind of amalgam is unknown to the common perfumers and apothecaries; and as the copper immediately discovers itself on the coal, the mercury flying off; a thing which happens not in the other amalgams of zink, bismuth, tin and lead, the whole

^c Lib. VIII. c. 8.

Lib. XXXIII. c. 6.

whole of the metal flying off gradually with a noise. The amalgams of gold and silver discover themselves by no noise in the fire; yet is there no apprehension from these, that the infus'd water of such an amalgam being us'd should cause any detriment to the person that takes it.

A Description of a burning and Medicinal Spring in Poland. By Conradus, chief Physician to the Queen: Together with an Explication of the Phenomena thereof; by M. Denis. From the Acta Eruditorum Lips. An. 1684. p. 326.

Translated from the LATIN.

Burning springs.

AMONG the many surprising phenomena of springs, the flame which some of them emit, and from which they are call'd *burning springs*, is deservedly reckon'd one: Such as is the spring of *Jupiter Dodonæus* in *Epire*, of which, besides *Pliny*^a, *Lucretius*^b makes mention: And such we know that to be in *Dauphine* in *France*, near *Grenoble*, which flames in the night and in foggy weather; and, therefore, call'd *La Fontaine qui brule*. And in the *English Philosophical Transactions* N° 172, there is an account of the like spring near *Wigan* in *Lancashire*.

Description of a spring in a mountain of Poland.

In the Palatinate of *Cracow* of the Lesser *Poland* there is a mountain, call'd the *wonderful*, cover'd both with aromatic plants and flowers, and aged oaks, resinous pines and firrs, and abounding both in fresh and salt springs, and full of metals and minerals of different kinds. In its middle to the south a spring of very clear water rises with a remarkable noise and vibration; and its ebullition or swelling increases or decreases with the moon. The slime settling at the bottom is said to be of service in the itch, inveterate gout, palsy and the like more obstinate disorders. The odour of the water in the spring is observ'd to be very fragrant and highly balsamic; in taste it resembles the sweetness of milk; and besides its medicinal virtue, which was experienced in the different diseases of horses, it also purges men, sometimes by stool, and sometimes by urine: Yet so that such as it does not thus immediately affect, do, notwithstanding, perceive a chearfullness and peculiar vigour from it. Hence the neighbouring inhabitants scarcely ever have any fit of sickness, but are very long liv'd; so as generally to arrive to 100 and 150 years of age. It may be carried a great way, and be kept for a pretty long while without spoiling. Upon evaporation it exhibits a sort of blackish bitumen, very serviceable both in recent and inveterate ulcers. In the spring it freezes not by any degree of winter-cold; nay, which is surprising, by approaching a torch thereto, it flames like the subtilest spirit of wine; so that the flame is

agitated

^a Hist. Nat. Lib. II. c. 3.

^b De rer. natur. lib. 6.

agitated and skips upon the surface of the water like bubbles: And therefore, this spring is call'd *ignis fatuus*. And this fire never goes out of itself, unless it is brush'd with brooms; as about 35 years ago the inhabitants neglecting to extinguish it, by gradually proceeding thro' subterraneous cataracts, it reduced both the roots of the trees, and thereby all the neighbouring wood to ashes, lasting almost for three years, before it could be perfectly extinguished; from which time public watchmen were appointed to prevent such burnings. But while the water burns but for a little time, it loses much of its force, which it scarcely recovers in 14 days: And tho' this flame soon consumes wood; yet it is so subtile, as not to heat the water: But when the water is drawn out, it is felt as cold as that mention'd by *Lucretius*; nay, neither does it flame out of its spring, tho' kept in vessels closely shut. The inflammability of this fountain, unknown to former ages, is evidently shown by being set on fire in a storm of thunder: Hence the wood-hewers from the neighbouring wood cutting twigs from the trees have extinguish'd the fire by beating the surface of the water therewith: From which time being sometimes afterwards, for experiment sake, set on fire by applying a torch, it was again extinguish'd by the motion of the twigs.

M. *Denis* in the following manner explains the theory about the 'afore-said properties of this spring: And that its motion and agitation answers to that of the moon, he supposes to happen by its communication with the sea, whose flux and reflux depends on the different phases of the moon, in regard that a subterraneous cataract lying between the sea and this spring is to a certain height only fill'd with water; but the rest of it, because it exceeds the *equilibrium* of the sea, with air: Hence when the greatest elevation of the sea about full moon rushes into this canal; and consequently, urges the included air and vapours towards the spring, the spring must necessarily be fill'd with water. On the contrary, if the sea does on the decrease of the moon, subside, the sea-water by retiring along with the air and vapours condensable into water, drains off much water from this spring.

He derives its medicinal virtues from a more copious sulphur, as the grand *panacea* of diseases; and with which the veins of this mountain abound, whose vapours also being lighter than the particles of water do by their *nifus* and tendency cause the noise and boiling of this spring; and at the same time its fragrancy; while the grosser particles unite into a slime, which falls to the bottom: He says, that the bitumen, which remains behind after the evaporation of this water, is, as it were, a natural balsam of sulphur, produced by the frequent agitation of the sulphur and water on each other. And in like manner he ascribes its inflammability to sulphur and to its exhalations bursting out of the water; and that, therefore, the flame floats upon the water, but is extinguish'd and stiff'd by beating it with the twigs; in regard that by this means these spirits or sulphureous

Explication of the properties of this spring.

Its medicinal virtues whence deriv'd.

miasma's.

miasma's are a-new involv'd in the aqueous particles from which the endeavour to recede: So that, indeed, being consum'd by the deflagration, the water loses much of its medicinal virtue; and that, therefore, it takes not fire out of its spring, because it contains few sulphureous particles, and those envelopp'd in water, and depriv'd of the *impetus* and impulse of the spring; which, notwithstanding, being present, the water within the spring eludes all force of cold in the manner as stronger spirit of wine does.

The Oil and Gall of Vipers, excellent Ophthalmics, &c. By Georg Wolfgang. Wedelius. From the Miscellanea Naturæ Curiosorum. An. II. viz. 1671. Obs. CXXV, seqq. p. 206. seqq.

Translated from the LATIN.

Oil of vipers a singular opthalmic and how us'd

AS oil of vipers surprisingly pleases the eye with its sparkling and purity, so, besides its other uses, it is a singular opthalmic. It is us'd two different ways; either the eye-lid is anointed therewith, and this is of service in comforting the sight and dissipating humours; or which is a better and speedier method, a drop or two of it is, with a clean-writing pen with a blunt point, deriv'd into the eye itself. It is a divine remedy and kept a grand secret in most affections of the eyes, but especially in haws of the eyes, applied either simply, as was said, or first gently warm'd: It soothes acrimony; is a lenient, detergent and consolidating medicine, so as not to be exceeded by any other: And with this oil alone I have very often in a short time remov'd haws and tubercles, discuss'd redness and remov'd other affections of the eyes. In wounds of the eyes it is a present remedy. It is the only medicine in specks, clouds and haws remaining after the small-pox. But what is chiefly remarkable is, that as often as it is dropp'd into the eye, in a small time after there runs out a matter, like white butter or *pus*, and thus it deterges without any smarting. I might cite many experiments, whereby I found it of use in haws, in an opthalmia, in a suffusion, and in ulcers of the eyes, especially after the small-pox; and in a particular instance, in restoring the aqueous humour in a wound of the eye, but without recovering the sight, as the wound was too deep. I, moreover, gave it internally to two consumptive patients with success: And as some phthysical persons are recover'd by the fat or oil of dogs, why should not the balsamic fat of vipers have the same effect? In this disease, when externally anointed on the spine, it proves of service, and on that account stands commended by *Cardan*. It also consolidates other wounds.

Vipers gall mix'd with sugar, a successful opthalmic

As the gall of the pike-fish, mix'd with a little sugar (after premising the proper evacuations, and at the same time applying a vesicatory) does accord-

according to the experience of *Scultetus*;^a successfully remove beginning cataracts; so the same is far more speedily effected by vipers-gall, by applying which in the same manner I have discuss'd a beginning suffusion; I have also often mix'd it with the essence of copper, made with *Malmsey* wine, and describ'd by *Angelus Sala*^b; and thus I have heightened an opthalmic of wonderful efficacy in itself with the accessional virtue of the viper; and I use it with success in these disorders of the eyes.

Vipers gall is charged with a discussing volatile salt; thus the very salt of vipers, dissolv'd in pure water, and dropp'd thrice a day into the eye (the patient lying for some time on his back) stands recommended by *Severinus*.

Sugar, partaking of the nature of salt, when added thereto, attempers the mucosity of the gall, and by its own proper deterging virtue increases its efficacy. With this alone a certain woman about *Magdeburg*, some years

ago, made considerably rich, by blowing into the eyes of patients, troubl'd with suffusions, a very subtile powder of sugar; and by repeating the medicine she recover'd a great many. *Angelus Sala*^c has sufficiently enlarged on the praise of copper. But besides these medicinal prescriptions, there are also other things to be observ'd about a suffusion; on which head there is an elegant passage in *Seneca*^d. 1. 'There is, says he, a remedy necessary for purging and clearing the sight. 2. The physician does not only cure, but also caution; you are not, says the physician, to rush immediately into broad day-light; but you are first to proceed from a greater degree of darkness to a less, and gradually accustom yourself to bear the open light. You must not study after a meal, nor give your orders with passionate and swollen eyes; and you are to avoid the cold blowing directly into your face, and the like; and these precautions are of no less service than the medicines themselves'.

Michaelis highly commends the liver of a viper, as a specific in epidemic dysenteries. I sometimes made trial of it; and, indeed, without success in some cases, by reason of the violence of the distemper; namely in such cases where the urgent symptoms and copious stools requir'd some other method; yet a certain young woman, troubl'd with a dysentery, after finding no relief from any other means, upon using the liver of a viper, mix'd with other things, found a sensible relief: But in this case the liver should be separated from the gall-bladder, as gall stimulates: But if you would incline to administer it in hard labour, it is more advisable, that the liver be dried along with the gall and employ'd; for, as the gall of an eel by *Helmont*'s experiment promotes so successfully the birth, we may with manifest advantage expect the same effect from the liver of a viper.

Vipers gall en-
dard with a salt.

Sugar an excel-
lent opthalmic.

The liver of the
viper an anti-dy-
senteric and faci-
litating the birth
Obs. 127. p. 209.

^a Armam. chirurg. Tab. XXXIII. p. 40.

^b Sept. plan. terrestr. p. 211.

^c I. c.

^d Epist. XCIV.

Experiments, wherein is plainly shewn, that the Pulvis Pyrophorus, otherways call'd Homberg's Phosphorus, takes Fire in the same manner as Quick-lime, when moisten'd, heats. By Joh. Godofr. Teske. From the commercium Literarium Norimbergense, Specim. XXVII. p. 213.

Translated from the LATIN.

Various opinions
about the manner
of the burning of
the pulvis pyro-
phorus.

IT is at this day a thing well known, that that grey powder (which Homberg first taught to prepare from a fecal matter, but Lemery, the younger, from meal, seeds, honey, the roots and leaves of trees, the yolks of eggs and a great many other matters) does when expos'd to the open air, take fire; and not only glows like a coal, but is cover'd with a sulphureous flame observable in the dark: But the cause of this spontaneous burning is not hitherto so well known to philosophers; for, some hold, that true fire is actually present in every sensible place, and they imagine, that its particles enter the pores of the spongy part of the powder; and that that part of the powder, being like a kind of fuel, very easily takes fire: But they fancy, that the burning is nourish'd by the sulphur, of which the powder, especially when glowing, strongly smells: Whence it also happen'd, that they call'd this powder the *magnet of the aerial fire*. Others, on the contrary, are of opinion, that the *pulvis pyrophorus*, expos'd to the air, does not attract the particles of fire, but is impregnated by the vapours of the air, and thus its burning is promoted: And, indeed, the latter opinion seem'd always to me preferable to the former; and I have given in to it in a *Dissertation* I publish'd in 1729, entitul'd *de igne ex chalybis Silicisque collisione nascenti*, induced thereto from several reasons, which I had read in the *Memoirs of the Royal Academy of Sciences*^a; as also from the frequent observations I myself had made; for, 1. It takes fire more easily in a moist than in a clear air. 2. The grey powder, not being sufficiently provided against the access of the air, is chang'd into a darker powder, which gives a hint, that it has imbib'd some humidity. 3. It gradually loses its virtue, (and, indeed, the sooner, if you restrain not the approach of the air) and only recovers it again after calcination, &c. But tho' these arguments might determine one to either side, yet they were not sufficient to convince him of the truth of the matter: Hence being about to enquire, whether any one had given a demonstration of this *phenomenon*, I turn'd over the writings of several philosophers, but without lighting on any thing to that purpose, till I myself had hit on the method of putting the matter beyond all doubt. I had about three months before, some toasted and ground coffee by me, which I had already us'd; after I had kept it for three weeks

The author's experiments.

^a An. 1715. p. 20. seq. p. 23. 41. — An. 1711. p. 243. seq.

weeks at least in a glass-veffel with a glass-stopple, I expos'd it to the air in a stove, and it would no longer take fire; I, therefore, open'd the window, that the air, which was then rainy and moist, might insinuate into the powder; but neither thus did I effect its taking fire, tho' it had been expos'd to the air for almost half a quarter of an hour: At length it came into my mind, that I had with some probability discover'd, that the powder was set on fire by moisture; and I took the hint of moistening a part of the powder on a paper: Wherefore, spitting upon the paper, I so inclin'd it, that the spittle should touch the powder, upon which I immediately observ'd the powder in an agreeable manner to take fire precisely in that place, where the spittle touch'd it; yet I was still uncertain, that the powder took fire on account of the approach of the spittle; nay, indeed, I suspected that it was already heated before it was moisten'd, because, upon the approach of the spittle to the powder, I had not only heard a kind of hissing noise, like what is produced by water sprinkled on live coals, but I had also observ'd sparks bursting out therefrom; I, therefore, often repeated the same experiment, yet always with the same success; and even then, when I immediately moisten'd the powder just put upon the paper, this remov'd every doubt with me: And likewise by repeatedly communicating a vapour to the powder, I observ'd it at first to emit a very strong sulphureous stench, but at length altogether to take fire; which so much the more confirm'd me in the opinion, that the burning of the powder is promoted by moisture, because in this manner I found, that the whole of it is set on fire, if the whole of it be thus moisten'd; and on the contrary, if only a part of it be wetted, it only takes fire in some part: Besides, when the powder had now lost almost all its virtue, and neither moisten'd nor impregnated with vapour would it any longer take fire, yet upon moistening it with water, I observ'd it conceive so much heat, as to burn the finger laid thereon, just as quick-lime does when drench'd in water: My opinion, therefore, which had only hitherto been a probability, was now establish'd beyond all doubt by a threefold experiment. But the reason, why I was not sooner confirm'd about the manner of the burning in the *pulvis pyrophorus* is, that I was always apprehensive, I should have moisten'd it too much; and I doubt not, but this has been the reason, why others have not hitherto experienc'd the same thing.

An Observation on the Integument, peculiar to the Membrane of the Tympanum of Fœtus's. By Christoph. Jac. Trew. From the commercium Literarium Norimbergense. An. 1731. Specim. II. p. 13.

Translated from the LATIN.

A peculiar small membrane observ'd standing before that of the tympanum.

THAT a peculiar small membrane, or a certain integument (standing before the membrane of the *tympanum* of *fœtus's*, not yet born, or but lately so, and always observ'd by the latest anatomists) is a real membrane and not spontaneously disappearing after the birth, as those famous anatomists, *Kerkringius*, *Ruysch* and *Heister* suppose, I formerly asserted in the *Act. Physic. Medic. Acad. Nat. Cura.* being convinced thereof by a fourfold observation on the bodies of adults. After this I also found, that the common opinion was maintain'd by *Waltherus* in his dissertation *de Membrana tympani*^b, publish'd at *Leipsig* An. 1725; and that to this opinion too gave in *Jac. Valent. Hirschelius* in his dissertation *de præcipuis partium fœtus ab illis adultorum differentiis*, publish'd at *Strasburg* An. 1729. The reading of these things rais'd in me a desire of more accurately enquiring into the condition of this integument in young subjects; and for this enquiry I allotted a *fœtus* of 6 months old: And upon laying bare the *meatus auditorius*, and very carefully loosening it all around from the bony ring, this integument appear'd in the manner, as it is commonly describ'd. Now in order to be assur'd, whether this integument (which to others seem'd to constitute a membrane of a softer and laxer kind, and as it were, a temporary one) had the structure of a real membrane, I caus'd blow by a pipe into the *meatus auditorius*, at that time greatly constricted: And thus more than once the said integument was not only elegantly distended like a small bag, but when thus distended suffer'd itself to be dried whole and entire; from which I think it appears, that there is no reason to doubt, but that this integument may and ought to be taken for a real membrane. But if any one will have it a peculiar sort of membrane and not continued with the *tympanum*, he has readily my suffrage; for, thus indeed, it always appears in young subjects, but how it appears in a fresh state in adults, I own I have not hitherto learn'd by experience; for, such as I have seen and observ'd in these latter subjects had already undergone a long continu'd maceration.

^a Vol. II. Obs. 56. ^b § 10. seq. ^c § 7.

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Stones,



ACTA GERMANICA: OR, THE LITERARY MEMOIRS OF GERMANT, &c.

A new Invention of Hot-Beds, receiving their Heat from the Steam of boiling Water. By Martin Triewald, F.R.S. Capt. of Mechanicks, and Milit. Architect to the King of Sweden. Taken from the Stockholm Acts.

Translated from the SWEDISH.



THE consideration, that to promote vegetation, a constant moisture, as well as heat, is absolutely necessary, has put me upon contriving hot-beds, which may enjoy both, as long as can be desired, and that after the following manner.

In a room not far situated from my hot-beds, I have caus'd a round tower T, to be built of bricks, Plate I. Fig. 1.
six foot high, and one foot in diameter a-top, and 18 inches below, near E.

Fig. 2.

At top of the tower, there's a cover L, made of potter's clay, and burnt, which, besides being well made to close the top of the tower, is made to exclude the air, by being well daub'd with soft clay, every time the tower is fill'd with fuel.

Near the lower end of this tower there are two openings, the one just over the iron grate H, where the fire is kindled at *h*, and the other is the

ash-hole *a*, where the ashes are taken out; over against the opening *b*, is a hole *g*, thro' which the flame plays, under the bottom of the still *A*, and so sweeps about the sides of the boiler or Still in the flews *r, r, r, r*, going in a spiral line, like a female screw, about the boiler *A*, and lastly into the chimney *S*. By which contrivance, very little fuel will keep the water boiling, and emitting steam in the aforesaid Still.

An iron door is fix'd before the opening *b*, which is shut as soon as the fire is well kindled on the iron grates *H*.

Plate L. Fig. I.

Near the boiler or Still *A*, stands a reservoir for water, *BDCE*, of lead; near the bottom of the same there's a valve *V*, solder'd to the end of a leaden pipe *RP*, of half an inch bore, which pipe reaches from the valve *V*, to the boiler, and thro' its cover down to within one inch near to the bottom of the same, where this pipe is open, but well solder'd to the top of the still near *P*.

On one edge *DE* of the reservoir, is fastened an upright stander, on which lies *in equilibrio* a leaver, with a sweep or segment of a circle *KI* at each end of it; and on each of these sweeps are fastened little brass chains, with their hooks, and strong brass wires fasten'd to these hooks: At one end of these wires the cover of the valve *V* is fastened; and at the other chain hanging from the sweep *I*, is likewise fasten'd a strong brass wire, going thro' a small hole in the Still: At the end of this wire in the boiler, is fastened a piece of wood, turn'd like an anchor buoy *b*, or rather an hollow ball of thin copper, with a small hole at top to let out the rarefy'd air; which buoy swims on the water, when the pan is fill'd to its proper height with water; but, as soon as the water begins to boil and diminish by the steam that is rais'd, this buoy sinks with the surface of the water, and by its weight pulls down the end of the leaver *I*, and raises the other, and so by means of the wire, hanging from the sweep *K*, opens the valve *V* at the bottom of the leaden reservoir *BDCE*, and then the water runs thro' the valve *V*, and the pipe *RP* down into the boiler, till the water is risen to its first height, when the buoy can no longer press on the arm *I*, of the leaver, or keep the valve any longer open, which immediately shuts by its own weight; by which contrivance the water in the boiler or Still is always supplied, and kept to an equal height, as long as there is any water left in the reservoir, without the trouble of taking off the head, to look into the still or boiler, which otherwise one would be oblig'd to do.

On the top of the boiler, there is a valve *v*, loaded with small leaden weights, which are proportion'd to a lesser force of steam, than what will make the head of the still fly off: So that when servants are careless, and raise too strong a fire; or if the pipes, which go from the head under the hot-beds, should by any casualty be stop'd, then the valve *v* gives notice, and the steam raises the top of the valve, streams out, and is prevented from throwing off the head, or bursting the boiler.

From

From the head goes a leaden pipe, *r, r, r*, under, or above the ground, to the hot-bed *d, d, d, d*, and spreads itself near the same into three branches, which go thro' the side of the hot-bed, and join into three pipes, *R, R, R*, made of brick earth, and burnt in a potter's oven, from four to six inches diameter, the length as long as they can conveniently be made; viz. about three foot, with proper joints, to fit each length to its fellow: The half of these cylindrical pipes, or so much of their area as turns upwards, when laid in their places, are full of small holes, thro' which the steam and heat rise up into the incumbent earth. Next to these pipes, I have laid tanner's bark, which readily lets the steam and heat pass up into the incumbent earth, and, at the same time, prevents the earth from falling thro' the holes, into the pipes.

When these pipes are laid the full length of your hot-beds, they are all to be join'd to, and terminate in a leaden cross-pipe *t*, whose short end *u*, goes thro' the side of the hot-bed; to which end I have fix'd a cock, through which the steam, that is condens'd to water again, in the earthen, or leaden pipes, may be discharg'd; for which reason, all the pipes are laid a little sloping, towards that side where the cock is fix'd. This cock serves, however, chiefly to regulate the heat, according to a botanical thermometer; for when it opens more or less, the heat is increas'd or diminish'd.

Plate I. Fig. 3.

The tower, which the profil *T*. represents, serves to this purpose, that when the same is once fill'd with fuel or coals, you may have, for a day or two, according to the bigness of the tower, a constant and steady fire under the Still or boiler; for as the fire receives no air from the top of the tower, because the cover *L* is very well secur'd, that no air can enter, nor get out that way; so it is impossible that more of the fuel can be kindled, than that is next to the grate *H*. The fire is, besides, very easily regulated, to what degree one pleases, by means of the door at *b*, and by closing the ash-hole, and is entirely put out, when both are clos'd up.

Fig. 2.

The coals, with which the tower is fill'd, sink down upon the grate, and maintain a constant fire under the boiler, as long as any are left; and when once the fire is regulated by a thermometer, placed under the windows of the hot-bed, the heat must always remain the same, as long as any coals are left in the tower.

The advantages this invention has, before all other hot-beds, hitherto invented, are as follows.

1. Here is not only warmth, or heat obtain'd, but likewise subtil warm vapours, which chiefly promote vegetation, according to the many curious experiments, which that learned and great philosopher, Mr. *Stephen Hales*, has publish'd in his *Statical Essays*.

2. That the heat of these hot-beds, may be regulated according to pleasure, and last as long as one pleases.

3. That this invention is such, that it requires very little attendance.

B 2

4. Hence

4. Hence there is no necessity of watering the plants in these hot-beds, or of being oblig'd, for that purpose, to open the windows in cold weather, as the steam, which comes from the boiler, goes thro' the holes of the pipes, up the tanner's bark, into the roots, and pushes forth their growth, to a surprising degree, without giving the plants any foreign taste, as dung is supposed to do.

5. To raise exotick hard-shell'd seeds, nothing can be more proper, than these hot-beds; because you may have heat and moisture, to what degree you please, which that most ingenious gentleman, Mr. Philip Miller, has found to be necessary for raising *coco-nuts*, *bonda's*, &c. See *Philosophical Transactions*, N^o 403.

6. By this invention one may, in orangeries, and green-houses for exotic plants, as *musa*, *anana's*, &c. during winter, imitate the half year's warmth, and moist air, of the *Antilles* islands in *America*.

M. Cassini's new Method of observing the Parallax, and Distance of the Planets from the Earth, verified at Rome, by the Abbé Francis Blanchini. Taken from the *Acta Lipsienfis*. An. 1685, p. 470.

Translated from the LATIN.

The earth's semi-diameter.

The measure of the distance of the planets.

THE length of the earth's semi-diameter, small, it is true, if compared with the vast extent of the heavens, yet sufficiently large for perfecting astronomy, is the standard by which we measure the distances of the planets. According to the quantity of the angle which the earth subtends, when view'd from different parts of the æther, we may, by trigonometry, find the distance of the point from which it is view'd: Consequently, as the sine of half the angle, under which, for instance, the earth, if view'd from the moon, would appear: is to the whole sine:: so is the semi-diameter of the earth: to the distance of the moon, in semi-diameters of the earth too. The whole difficulty, therefore, of determining the distance lies here, namely, how an observer on the earth can measure the angle subtended by the earth's semi-diameter, were it view'd from that point, the distance of which, from the earth, we want to know.

How this distance was formerly found.

Plate I. Fig. 4.

Formerly astronomers found the quantity of this angle by means of two observers, who at the same time view'd the same star from different and distant parts of the earth. Suppose, when *Mars* was at M, one of the observers stood at V, the other at Z, two points on the surface of the earth distant from each other, and both observers mark'd the point in the heavens, to which *Mars* seem'd to be referr'd. In this position, the observer Z would see *Mars* at the star S, along the right line

line ZMS , and the other observer, being at V , would see it at the other star R , along the right line VMR . Then by comparing both their observations together, they concluded from the difference RS , that the angle RMS (which, considering the vast distance of the fixt stars, is almost the same with the angle RZS) is the same with the angle ZMV , at the vertex, namely the angle under which ZV , the portion of the earth, would be seen from *Mars*.

The celebrated *M. Jo. Cassini* rightly observes, that the stars themselves may serve instead of another observer. Wherefore, in his learned treatise on the comet of 1680, he shews a very accurate and concise method of performing it by one observer only, who by making several observations the same night, may view the stars thro' a telescope armed with a micrometer. It will be worth while to explain more fully this admirable contrivance.

We are, therefore, to enquire, by what means a single observer upon the earth, may find the quantity of the angle, which the earth's semi-diameter would subtend, were it view'd from any of the planets.

Suppose, I am placed in the axis of the world, and view the earth *D*. Plate I. Fig. 5.
The point *D* will represent the pole of the earth's equator, which will be fitly represented by the circle ABC . Suppose the plane BAC indefinitely produced; it will then represent the plane of the æquinoctial in all the spheres of the planets it touches, even in the most distant stars, when so far produced. Let, therefore, *Mars* be in H , which let us suppose to be in the plane of the æquinoctial. In order to shew its diurnal revolution, we have nothing else to do, than on the centre *D*, with the distance DH , to draw the circle $HMK E$; which *Mars* will seem to describe in 24 hours, if it be suppos'd not to proceed by its proper motion *in antecedentia*, or contrary to the order of the signs. Thus when we come to shew the diurnal motion of *Jupiter*, *Saturn*, and even of the stars, it will be sufficient to describe from the centre *D*, concentric circles, corresponding to their distance. And if we divide one of these circles into 24 equal parts, and thro' each of them draw planes perpendicular to the æquinoctial, and intersecting each other in the point *D*, we shall also have the hour-circles, which, with respect to places on the earth, will serve instead of meridians. Let one of these planes be $LHAD$, that is to say, the meridian of the place *A* under the *Equator*, where suppose an observer views *Mars* H and the star L , both which suppose to be in the same plane of the *Equator*, with the observer, and let their limbs touch in such manner, that the same line DHL may pass thro' the limb of the planet, and of the star, which for the easier construction, it is best to suppose. If neither the star or *Mars*, had any other motion, than what we call their diurnal revolution, they both would, in 24 hours, return to their former place, and if that diurnal motion were equable, they would both in six hours be in the plane

plane EDM, perpendicular to the meridian and passing thro' the pole D, namely in the circle of the sixth astronomical hour. If an observer, therefore, were at the same time placed in the axis of that motion, and in the plane of the *Equator*, that is, in the centre of the earth, he might always see *Mars* and the star, and both bodies to touch each others limb the same way, whether *Mars* and the star be in the plane DHL or DMR. But it would not be the same case with the first observer, whom we supposed to be at A, who, it is true, will in his meridian see, in the same right line AHL, the limbs both of the star and of *Mars*. But when they are in any other meridian DR, which in respect of the place A is the circle of the astronomical hour at six, the observer will see *Mars* in the plane AM, but the star in the plane AR; consequently *Mars* will appear to him to move *in antecedentia*, or the star *in consequentia*; tho', it is true, both will, according to the supposition, be equably affected by their diurnal motion.

Moreover, as the observer knows, that both move equably, he will find, that both are in the plane of the true astronomical hour at six: And he will also find, that *Mars* had passed the plane of the sensible hour of six, a little before the true hour of six, since the sensible hour of six, with respect to the place A, is not the plane EDR, but the plane APN. For the difference of time between the transit of *Mars*, for instance, over two planes of six hours, namely AP, the sensible hour of six, and AM the rational or astronomical hour of six, will be known by the portion of the diurnal parallel PM described by *Mars*, which will be equal to the angle PAM, or the alternate angle in the parallels AMD, to wit, the angle under which the semi-diameter of the earth would be seen from *Mars* M: So that if that portion MP were one degree, for instance, *Mars* will be seen to pass thro' the plane AP in four minutes of time, before six hours are elapsed from its transit over the meridian. For the farther *Mars* is distant from the earth, the latter will be seen from the former under a lesser angle, as is plainly demonstrated by optics: Consequently, the lesser will the difference be of the transit of *Mars*, over the plane of the sensible and rational hour of six. And if the greatest elongation of that star be such as the distance of the fixt stars, the angle ARD, or its equal NAR, will be so small, as quite to escape our senses, and will be seen in the plane AN, in the same sensible time in which the star comes to the plane DR.

And now we see, how the star itself, or rather a pendulum clock together with the star, may serve instead of an observer, who lives in C. For what else would the observer at C do, than ascertain, that he saw the star and *Mars* in the same plane of his meridian, or of our astronomical hour at six, while we viewing these stars, would observe their situation different. And this is chiefly perform'd by our clock, while it tells the hours
after

after the transit of *Mars*, over the meridian. For since it is evident, that the star *L* will, six hours after its transit over the meridian, be in the plane of the sixth hour *DR*, we are pretty sure, that the star is in that place, if it be six by the clock. For as with regard to the fixt stars, the plane of the sensible hour of six, agrees with that of the rational hour of six, if after six hours from the transit of the star, over the meridian, some plane be disposed so as to pass thro' our eye and the star, and be parallel to the axis of the world, it will be the plane of the sensible hour at six, in which the star must necessarily be. And *Mars* will appear to differ from it so many minutes of its parallel as correspond to its parallax. Let, therefore, the number of minutes, which pass between the transit of *Mars* and the star, be observed by means of a pendulum clock. For thus it will happen, that by taking each minute of a diurnal parallel of *Mars*, to be four seconds of time, we may find the angle *MAR* or *MAN*, which as to sense, is the same with that we have explain'd, or with the alternate angle in the parallels *AMD*, that is, the angle under which the earth's semi-diameter is seen from *Mars*, *Q. E. D.*

Having found this angle, if in the rectangled triangle it be, as the sine of *AMD* found by observation: to the whole sine of the right angle *D*:: so the line *AD*: to its fourth part: we shall find the quantity of the line *AM*, or the distance of *Mars* from the place of the observer *A* in corresponding parts of the earth's semi-diameter.

The best way of observing this difference of time between the transit of *Mars*, and the star, is shewn by *Cassini* in the same treatise; and that by means of a peculiar machine, armed with a telescope and micrometer. In the concourse of the focal of the object and eye-glasses, are set four, or more threads, intersecting each other at right angles. The telescope thus furnish'd, is turned so long till some of the stars which are near *Mars*, appear to move along some of the threads, while its image in the telescope moves parallel to the *Equator*; and then it is plain, that even the threads are parallel to the *Equator*. And these threads which are placed at right angles with the first threads, do fitly answer to the circles of right ascension in the small space of the heavens, which the telescope takes in; especially, when the stars, which are observ'd, are within the *Tropicks*; as in fig. 6. when the threads *EC*, *BD*, parallel to each other, are at right angles with the parallel lines *EB*, *CD*. Let the image of one of the stars which are near *Mars*, be in *C*, that moves straight along the thread *EB*, while the star carried round by its diurnal motion, describes its way by its image in the focus of the glasses, it will appear, that the thread *EB* is parallel to the *Equator*; consequently, the threads *EC*, *BD*, which are at right angles with the former thread, will answer to the circles of right ascension. Only wait till *Mars* *F* carried round by its diurnal motion, shall reach the thread *AC* in *H*; then mind the clock, and reckon the

Cassini's peculiar machine.

Plate I. Fig. 6.

the vibrations that happen between the transit of *Mars* F, and of the star G, which will appear to reach the same thread soon after *Mars* does. This time being reduced to the minutes of a circle, will give the minutes of *Mars*'s parallax; consequently, we may, by trigonometry, find its distance from the earth.

Hitherto, for the easier construction, we have supposed several things, to wit, that *Mars* has no proper motion, that the observer lives at the *Equator*, and that the difference is taken in the circle of six o'clock, (this last was only shewn as an instance; for really such an observation cannot be made in that position of the sphere, as the circle of six o'clock, with respect to a place under the *Equator*, is the horizon itself; and upon several accounts such observations cannot be made in the horizon) what we have, therefore, hitherto considered as a possibility, in suppositions made on purpose, let us reduce to practice in those cases where there are no such conditions supposed: As in our horizon, when we observ'd *Mars* in 1685.

Plate I. Fig. 4.

First, Let the observer be in any other parallel of the earth, a pretty way from the *Equator*, suppose the parallel of *Rome*, which is $41^{\circ} 56'$ distant from the *Equator*, the parallax of the right ascension observable here, or the difference of the sensible hour of six, will be less than the true one: For the place of the observer will not be in A, but in some intermediate point between D and A, namely in I, thro' which since the plane of the sensible hour of six, IQ, should be drawn, the difference of the planes of both hours at six will be less; consequently, the parallax will be so too. For the greatest parallax of the right ascension observable here, will have the same proportion: to the greatest parallax observable under the *Equator* :: as the line ID: to AD, namely :: as the co-sine of the pole's elevation: to the whole sine. Consequently, if the greatest parallax of right ascension, corresponding to *Mars* when in the *Equator*, be observ'd in the parallel of *Rome*, in order to find the quantity of the parallax, which shall be observ'd by such as live under the *Equator*, it must be as the co-sine of the latitude of *Rome*: to the whole sine :: so the parallax of right ascension observ'd at *Rome*: to the parallax observed in St. *Thomas*'s island, or in any other place under the *Equator*.

Secondly, Let us suppose, that the first observation is made, while *Mars* is in the meridian; but that the second is not taken in the circle of six o'clock, but in the circle of three; for instance, here we must again suppose a two-fold hour, the one astronomical or rational, which passes thro' the centre of the earth, the other sensible, which is parallel to the former and is to be drawn thro' the place of observation. In fig. 4. the first will be DO, and the other IT, which will not be distant from each other the whole length of the line ID, but only that of the line IS, which is to ID :: as the sine of three o'clock or of the angle HDO of 45 degrees

to the whole sine. Let the proportion be as before, as the sine IS of the angle ADS: to the whole sine ID of the right angle S:: so the parallax of *Mars* observ'd in the circle of three o'clock: to that which may be observable in the circle of six.

Thirdly, Let us suppose *Mars* to be out of the plane of the *Equator*. The proportion must be stated the converse of the former; to wit, as the whole sine: to the co-sine of *Mars*'s declination:: so the parallax found in the parallel *Mars* describes: to the greatest parallax observed in any great circle; in the very same manner as we reduce the apparent diameter of the sun to the minutes of a great circle, when we measure it by means of a pendulum clock, while the sun passes thro' the *Tropics*, or thro' any circle out of the plane of the *Equator*.

Lastly, Bating the supposition of *Mars* having a proper motion in the order of the signs or contrary thereto. Let us suppose that it moves equally, or at least that it is uniformly and determinately accelerated or retarded, which is to be found out by means of several observations that are to be made the preceding and following days, while *Mars* moves over the meridian; consequently, we shall find the true place of *Mars* at each time; and if we compare it with the apparent place by the parallax, it will be the same thing as if we had supposed, that *Mars* had no other than a diurnal motion. For I supposed *Mars* to be at rest for this reason, that I might fix a determinate place for each minute. Thus since we can find this place, even if we suppose the motion of *Mars*, the clearness and the use of *Cassini*'s rule will appear without it.

How much astronomy is indebted to the learned *Cassini* for so admirable an invention, any one will readily own, who considers its conciseness, and compares the difficulty of former methods with it: For he himself says, that by this method he found out the distance of *Mars*, when being in opposition to the sun, it was nearest to the earth. By treading in the steps of so great a man, I myself have endeavoured to find the parallax of *Mars* when acronical. I have selected some of these observations, which I made on the days immediately after *Mars*'s opposition with the sun, and which seem'd to me to be the most accurate, and they are as follows.

Excellence of
Cassini's method.

Obs. Day H. ' " N. S.

May

I. 30 8 45 55 The preceding limb of *Mars* in its diurnal revolution at the thread EF.

Observations:
Plate I. Fig. 4.

After 106 vibrations of the pendulum (of which 92 are equivalent to one minute of time) the star A comes to the same thread.

After 365 vibrations from the transit of *Mars*, the star D comes to the same thread.

LITERARY MEMOIRS

Obs. Day H. ' " N. S.

May

- I. 30 8 45 55 After 375 vibrations from the transit of *Mars*, the star C comes to the same.
- II. 11 10 12 The preceding limb of *Mars* at the thread E F.
The star C at the same thread after 393 vibrations.
- III. 12 20 12 The preceding limb of *Mars* at the thread E F.
The star C after 399 vibrations comes to the same thread.
- IV. 31 11 23 55 The preceding limb of *Mars* at the thread E F.
- June
- V. 1 11 6 19 The western limb of *Mars* at the thread E F.
The star C comes to the same thread after 670 vibrations.

Comparison.

By comparing Observ. II. and IV. it plainly appears, that *Mars* had in 24 hours 13 minutes of time changed so much of its right ascension, as answer'd to the portion of the heavens run over during 142 vibrations. Consequently, if in one hour it equably changes its right ascension (which indeed it does almost equably, as plainly appears from Observ. II. IV. and V.) it is retrograde or elongated from these stars while $5\frac{1}{2}$ vibrations are performing. From Observ. I. to II. are 3 hours, 1 min. and $\frac{1}{4}$. Therefore if it was no ways retarded, it would accomplish so much of its ascension, as is equivalent to 20 and $\frac{1}{2}$ vibrations. But since at the time of Observ. I. it was retrograde with a greater degree of velocity, because its retrocession is daily sensibly diminish'd about five or six vibrations, it should in that time vary at least 21 and $\frac{1}{4}$ vibrations. This change I compare with Observ. I. and III. according to which it plainly varied 24 vibrations. Consequently, the greatest difference that can possibly happen, does not exceed 2 and $\frac{3}{4}$ vibrations. Now to come nearer in order to find the parallax.

At the time of Obs. I. *Mars* was distant from the meridian three hours, or 45 degrees, of which the one is 707. At the time of Obs. II. *Mars* was distant from the meridian 3 and $\frac{1}{4}$ minutes or 8 and $\frac{1}{2}$ degrees, whose sine is 148; the sum 855.

As 855 : to the whole sine 1000 :: so $2\frac{3}{4}$: to $3\frac{5}{8}$.

As 744, the co-sine of the latitude of *Rome* : to 1000 the whole sine :: so $3\frac{5}{8}$: to $4\frac{7}{8}$.

As 1000 : to 921 the co-sine of the declination of *Mars* :: so $4\frac{7}{8}$: to $3\frac{41}{8}$ or in round numbers to 4.

And now if 92 vibrations of my pendulum give 60 seconds of time, how many will 4 vibrations give? I find $2\frac{56}{102}$ or $2^{\text{h}} 36^{\text{m}} 30^{\text{s}}$. But $2^{\text{h}} 36^{\text{m}} 30^{\text{s}}$ are minutes of the *Equator*, and consequently $39^{\text{h}} 7^{\text{m}} 30^{\text{s}}$ of any

any great circle. Therefore, the greatest horizontal parallax of *Mars* is 39", and its distance from the earth is about 5250 of its semi-diameters. If you take its parallax in a round number, as 40", its distance from the earth will be upwards of 5100 of its semi-diameters. I have not minded, you may see the small fractions, in a matter where there is such uncertainty.

The Dissection of a Maniac, in whom one of the Ovaries was found hairy and steatomous. By Dr. Augustine Buddeus. Taken from the Acta Berolinensia.

Translated from the LATIN.

A Woman, about 20 years of age, and of an emaciated habit, was confin'd, thro' a raging madness, of which she finally dy'd. The corps being publickly dissected last year, in the *Royal Anatomical Theatre*, the following appearances were observ'd.

1. As there was nothing unusual externally, the muscles and scalp being remov'd, and the skull saw'd off, I found the *dura mater* extremely moist, and, after an incision of it, I observ'd the *pia mater* abounding with many vessels, which were turgid with a thin, dilute blood: This the rather surpriz'd me, as celebrated physicians have pronounc'd the blood of *maniacs* to be gross, and even adust or parch'd; and which, by obstructing the tender vessels of the cortical substance of the brain, they have consider'd as the cause of this disease: This I have no doubt, it sometimes is, tho' experience has convinc'd me 'tis not the constant one. The *dura mater* being carefully remov'd from the subjacent, tender membrane, a large bag presented itself, form'd by the *pia mater*, which contain'd a pound weight of a thin lymph, intermix'd with some bloody drops, and which occupy'd all the space to the cortical substance of the brain. This *cystis* was discover'd in the left lobe of the brain, and the greatest part of it was extended to the *basis* and posterior parts of the *cranium*. There was nothing farther remarkable, except, that the whole brain was very flaccid, moist, and of a mucous consistence.

2. There was little unusual in the *thorax*, besides a very strong adhesion of the lungs, which were mostly schirrous; tho' I observ'd further, that the right cavity was full of lymph, while the left was entirely free.

3. But I was infinitely surpriz'd on an apertion of the *abdomen*, which I effected with some circumspection, lest the situation of the parts might be confus'd. To which purpose, declining the common method of dissection, I did not lay open the whole *abdomen* at once, but left the abdominal muscles untouch'd for a palm's breadth from the *symphisis*, or coherence of the *os pubis*, in a direct line to the navel; that, the lower parts of the

belly being tight and streightened, the intestines should be press'd a little upward, and resist a procidence of the incumbent parts. But what ensu'd? To my great astonishment, on inspecting this cavity, I could scarcely discern an intestine. The relax'd and flabby ventricle was drawn excessively downwards; and that part of the *colon*, which is call'd the *arcus* or bow, represented the figure of a *Roman S*, and entirely occupy'd the whole cavity of the belly to the *Iliac* region. The muscles being dissected to their cohesion with the *os pubis*, for an inspection of the *pelvis* or basin, here I found the misplac'd intestines, somewhat dark and discolour'd, and surprizingly contorted and entangled together; while the mesentery, to which they were connected, was entirely scirrhus. The *omentum* or cawl, which was necessarily remov'd from its station, by the dilapse of the stomach and *colon*, was also found in this cavity, spread over the intestines, darkish, and filthily coloured. The liver, and other *viscera* of the lower belly, seem'd tolerably perfect, or, at least, had very little præternatural appearance.

On the womb

4. The intestines being remov'd, I immediately discern'd the womb to be exceeding hard, tho' in its natural shape, and made an incision to discover if there might be any particular inhæsion, which there was not. From thence I proceeded to observe the *ovaria* and *fallopian* tubes, and found the right ovary of a remarkable magnitude, equal to a hen's egg. Surveying it attentively without, I observ'd it to hang by an insertion or pedicle; the membranes involving it were tense, double, thick, and somewhat rigid, tho' lubricated with a clear fluid. It made no resistance to the pressure of my finger, but yielded, and retain'd the pit impress'd. From hence I conjectur'd that I should discover some *hydatides*, or perhaps a dropfy of the ovary, which *Ruyseh* has formerly noted in his anatomical and chirurgical observations, and promis'd as much to my assistants and auditors the more readily, as I could not think of any disorder, more congruous to the external appearances: But the event was different. For the whole circumference being open'd, it was entirely fill'd with hairs, mix'd with a suetty or unctuous matter within. To prevent any deception in such an unexpected case, I examined the hairs apart, washing them in water: They were about two inches in length, curl'd a little, and being apply'd to the flame of a candle, they burnt with a stink like that of nails, or other hair. Content with this, I considered the suetty matter they were intermix'd with, with much accuracy, which did not resemble melted suet, but was in distinct, small grains: This might probably be owing to some lymph in the ovary, which prevented the coalition of this unctuous matter into one entire mass. This ovary, clear'd from the parts it had been connected with, weigh'd exactly an ounce.

Fig. 6.

Conclusion

These are the most remarkable appearances I have observ'd in this wonderful ovary, which instance, supposing the like to have been already remark'd,

mark'd, may acquit such observers from the charge of fiction; since it seems scarcely conceivable, how such matter should arrive at such a situation. Moreover, we find *Ruyfch*, in different parts of his valuable collections, take notice of hairy tumours, and in his sixteenth observation he describes a similar one of the *omentum*; as another example, nearly of the same nature, is recited in the Acts of the Academy of Sciences at *Paris*. Such *phænomena* cannot fail of furnishing ample occasion for speculation and debate: As, whether these hairs always existed in their ovary, and in the condition we found them? or, if they grew and multiplied? As also, whether this morbid construction of the ovary might haply be the cause of the patient's madness? It is however a sensible concern to me, that I could not arrive at an exact knowledge of the period, when the deceas'd was first attack'd with this disease.

A new Discovery of the real Cause of the Increase of Corn.
By Prof. Wolf, at Hall. Taken from the Breslaw Collection, Ann. 1718. p. 588.

Translated from the HIGH-DUTCH.

MR. *Wolf* having resolv'd on a farther examination of that new discovery, mention'd by the Abbot *de Vallemont*, (in his curiosities of nature and art in the process of vegetation, printed in 1701,) where he observes, that a single grain is productive of several ears, which effect the Abbot supposing to depend principally on soaking the grain before it is sown; and it being manifest, that one grain, not soak'd, sown in a fertile ground, produces several ears, Mr. *Wolf* was put upon examining into the real cause of this natural increase, especially, when he found the modern hypothesis to be very ill grounded, to wit, that the principal grain contained as many corns in miniature, as in a 1000 or more years, might arise from a large one; and that therefore, by means of soaking, one year would produce as many stalks and ears, as otherwise they would in three, which hypothesis Mr. *Wolf* fundamentally contradicts: He first examines wherein the real cause of this wonderful increase consists, and then shews how it was discovered. He made an experiment in his own garden, in a fertile soil, with two grains of oats, and found, that each grain came up like those sown in the fields, with one sprout, which in time grew into a bunch, and at the time of harvest, the stalks were longer, the ears full, large, and heavy, exceeding by far the common field-oats; and having parted one of the bunches, he found that each stalk had its particular root, which he could easily separate; the other bunch he left remaining as it was, in the ground; and when it had rain'd after harvest, there came up new stalks, which shot into ears by *Michaelmas*; nay, upon

The occasion of
the discovery.

upon the rain which fell a little after *Michaelmas*, more green stalks shot up, so that both seed and harvest appear'd together. Whence he perceived, that out of one single grain, at first arose but one shoot, from which proceeded a stalk, therefore he concluded, that properly no more than one capital stalk was in the grain, and that the side-stalks had their derivation from another cause; and finding that the stalks neither proceeded from the grain nor the root, he search'd and examin'd the stalk itself, and was soon satisfy'd that the side-stalks had their derivation from the main stalk, or from each other. This emergence, or extrusion of the side-stalks, he represented to himself precisely, in the following manner. As on every stalk were found several knots full of marrow, while the stalks were quite empty, and observing no knot, but where a leaf sprouted, this made him reflect, that not only the knots in trees, whence the branches proceed, are found where the leaf grows, but likewise in other vegetables, in which side-stalks and blossoms sprout fresh out close by the leaf, of which the sun-flower is a plain instance, for when the flower has done blowing on the main stalk, new side-stalks and blossoms issue forth at every fresh remaining leaf. Whence he concludes, that a side-stalk could have sprung from no part of the main stalk, where a leaf or blade had not put forth, and that such a side-stalk had shot its own root into the ground: If then one or two leaves, which are nearest the root, have their knots in or close to the earth, then those knots strike, and grow into side-stalks from the matter, or marrow they contain; such side-stalk, separating itself in a little time from the original stalk, draws again one or two knots along with the earth, and thus each stalk may produce two new side-stalks, and so on to infinity, as long as it can receive proper nourishment: These were Mr. *Wolf*'s fundamental reasons, upon which afterwards he made the actual tryal.

Demonstration.

Mr. *Wolf* demonstrates, in what manner the cause of the increase in this tryal is ascertain'd: He proposes, 1. To put some grains somewhat deep into the ground, so that at least a pair of knots might lodge therein. 2. To sink these knots that are above ground, into the earth, before they grow hard. 3. To divide a whole bunch, and to examine into the knots and roots thereof. 4. Whether after the harvest a new seed may be raised? 5. Whether the seed may be winter'd? 6. To count the number of ears and grains. In the prosecution of this tryal he was for some time delay'd, but animated by M. *Leibnitz*, he made a second attempt: In the spring, he had a little box fill'd with mould, in which he put one grain of barley, and one of oats, and found that both came up with a single leaf; and after the growth of the second leaf, a side-stalk shot out between both; the like happen'd between the second and third leaf, so that even the side-stalks produced others. And having cover'd some of the new green stalks, above the lowermost knot, with earth, he found afterwards the same was burst, and had struck two roots, tho' there was as yet no appearance of

of a leaf; he left another knot longer in the ground, and found it shooting forth a new stalk: He had, at the same time, put some grains in his garden-ground, which had spread themselves into much larger bunches; but they were inadvertently pull'd up before he made his observations, to one bunch of oats, which was full, both of good and blighted ears. The cause of this unequal growth he ascrib'd to the pump water with which he had water'd those in the box, when that in the garden was moisten'd by the rain and dew. In examining the bunches, that had been pull'd up, he found that in the vast number of stalks, each was growing from the knot of another, above where its roots begin; yet so, that the root of one stalk had nothing depending on the root of another. He then enter'd upon a new experiment; he put both oats and barley, some in uncultivated ground, others in beds of asparagus, which had been dung'd in the spring; in the former there grew handsome bunches, particularly in the straw, but in the latter much larger and with fuller ears, but all of them with the before-mentioned circumstances: He once pull'd up in the field, a bunch of oats, divided it, and found 600 grains, altho', on account of the dry weather, many small stalks, which had sprouted slowly, were dry'd up: On one bunch of barley he found 68 ripe ears, and 21 not quite ripe, in the whole 1586 grains; to which adding the 504 dry'd grains there will be a product of 2090 grains from one single corn in an uncultivated ground.

As to the goodness of these barley corns, Mr. *Wolf* remarks, that 28 grains, were equal in weight to 30 of common barley; the grain was more solid, and promis'd a better flower: He also found, that the side-ears had shot much higher than usual in a common barley field. But principally he took notice, that some side-stalks had shot forth from the first knot above the root, a small stalk of about two inches long, notwithstanding it was an inch above ground, and incapable of striking root; whence he concludes, that at least a side-ear would thrive without a root, in case it had sufficient nourishment.

Remarks.

Having left some of the roots and stubble of the oats standing, he found them about the middle of *December* full of small stalks, and green sprouts; and he doubts not, but, had it been rye or wheat, the seed would have stood the winter out, and brought forth fruit the next year; he even supposes, that these young, and very late sprouts, would bear to be divided and replanted; and if so, every sprout would increase into a whole knot, or bunch. Thus much of Mr. *Wolf*'s fundamental experiments and reasons concerning the increase of corn.

As to the use and benefit of this new discovery in agriculture, Mr. *Wolf* demonstrates, that a field might be made 100 times more fruitful than it commonly is, when (1.) the seed is sown above an inch deep in the ground, whereby two knots of the main stalks would remain in the earth. (2.) When the grains are sown at least three inches one from the other, so that

Use and benefit of this new discovery.

that the side-stalks may have room to spread, and not want sufficient nourishment, without which the seed would be liable to the danger of being spoil'd or lost. He believes there are many, who wish to see this put in practice; but as it is impracticable to do it by the usual method, he hopes, that such as are experienced in agriculture, and have a genius, join'd to some practice in mechanicks, will find out a method to accomplish it; as in the mean time he himself did not doubt of discovering, at some leisure hours, something to answer this purpose.

Use to explain
natural philosophy.

Lastly, Mr. *Wolf* shews, that his new discovery may prove of general use in the explanation of natural philosophy: He observes, that since he discover'd, that in each knot, where there is a leaf, there is also a sprout with its root, he had different conceptions of several things, to what he had had before; and that in all the vegetables, where a leaf sprouts, there will be found an eye, which can strike root and shoot forth, if the stalk as well as the root touches the ground. This he has experienced in several vegetables, insomuch that, by the help of the microscope, he discover'd in every eye a root, by which it drew nourishment to itself, and therefore, if the eye or knot is to shoot forth, its root must remain unhurt; which observations were never made by either *Malpighius* or *Grew*, in their Anatomy of plants.

In planting of
lemons, &c.

Hence Mr. *Wolf* learn'd the proper circumstances in planting lemons, vines, carnations, &c. where the roots of the eyes shoot forth in the ground, in order to convey the more nourishment to the eye, that the miniature in the bud, may be able to grow; however, this cannot happen, where the knots are hardened, or where the root is obstructed from making its way, but only to such as are green and soft: This has been already observ'd in the knots of corn, which burst at the shooting forth of the root: Hence Mr. *Wolf* modestly contradicts what has been advanc'd, that all vegetables were not fit to be propagated by planting. He believes, that, according to the notion of *Agricola*, nature forms the root from the united juices, at the incision, but that such roots can be only the roots of the eyes, since nothing organical can be produced from an inorganical matter; and in this manner we are to account for the thriving of replanted twigs, which have a soft bark, and will not easily decay, of which the rosemary is a plain instance. On this occasion Mr. *Wolf* inspected the seed, and perceived that the same, as generally known, consists of the matrix, which serves for the first nourishment, and of the bud; this bud has a small root, two heart leaves, and one eye, from which he first discover'd the root; that part of the bud, which is lodg'd between the heart-leaves, contains not the whole tree, but only one single eye, since so much is represented in small, as what can grow from one eye. The heart-leaves serv'd to bring the eye to maturity, and to shoot forth. Having at last given his reasons, which induc'd him to take the
within

within the tree hidden part of the eye for a root; he explains, how from a kernel a tree is produced; namely, by the enlargement of a bud in the seed; also, how out of one leaf-eye is produced a tree, which is hid in the marrow of the knot the leaf proceeds from; namely, in the same way as in the seed: Also, how out of the roots there spring forth side-shoots, because the roots are furnish'd with marrow, and the marrow with eyes: Lastly, how the bark shoots forth branches, because thro' magnifying glasses it has been observ'd, that the inside of old barks contains a great deal of matter, that has an affinity with marrow; hence it is possible, that a tree depriv'd of its marrow, may sprout out branches from the bark. Since then this new discovery of the increase of corn, giveth so much light to the growth of trees and plants, Mr. *Wolf* has promis'd to neglect no opportunity of pursuing this enquiry; and for our part, we shall not be remiss in giving what account we can, of the discoveries, made in agriculture, by other gentlemen here in *Silesia*.

A spurious periodical Diabetes; by T. Bartholin. Taken from the Acta Hassn. Anno 1671, 1672. p. 19.

Translated from the LATIN.

ALL the physicians in *Copenhagen* were call'd to a consultation, on the case of Mr. *Bullich*, a Member of the Royal Council, and President of the City; who, after a chronical *Diabetes*, fell into a *Diarrhœa*, which sunk his strength, and at length carry'd this elderly gentleman off, in spite of the exhibition of the most experienc'd remedies. For some years before this, he labour'd under an extraordinary, and monthly profusion of urine, with pain, which was preceded by nephritic torments, and about the full-moon he discharg'd 24 pounds of urine, tho' he had not drank one pound of liquid: Nevertheless, this was attended with no visible emaciation of the body, as he continu'd of a vegete and plump habit to the day of his death. In the passing of this urine, he was sensible of an augmentation of pain, if the fire in his chamber was larger than ordinary. He discharg'd gravel also by stool, that was visible upon his linnen after this copious discharge, which induc'd us to conclude, that his blood was overstock'd with tartarous particles. I advis'd chalybeated milk for his *Diabetes*, which is recommended by *Augenius*. Another preferr'd that in which heated gold had been quench'd. The cure had been also attempted by transplantation, but without effect.

Observations on the Matrix, or Womb of Amber. Taken from the Breslaw Collection, July 1718, p. 1397.

Translated from the HIGH-DUTCH.

Whether amber
be a mineral or
vegetable pro-
duction.

IT has been long and warmly debated, whether Amber be a mineral or vegetable production. The ancient *Greeks, Latins and Arabs*, as well as *Olaus, Ruens, Scaliger, Baccijs, Servius, Hermolaus, Barbarus*, and many more, suppose it a gum, issuing from trees; their arguments are strictly examin'd, and fully represented from antiquity by *Andr. Libavius*. Others on the contrary, range it in the class of minerals, tho' in this they differ; for *Pytheas, Timæus, Theophrastus, Xenocrates, Hector, Poethius, Theophrastus Paracelsus*: and some others, ascribe the birth of it to the sea; while many others, as, *Agricola, Hefius, Mathiolus, Jordanus, Aurifaber, Willichius, Goebelius, Cordus, Fuchsius, Libavius, Kircherus, Hartmannus*, and indeed the greater number agree, that it is a fossile, and the fruit of *bitumen*, which opinion is maintain'd and defended from many arguments by *Libavius*: And this appears the more reasonable, since in most places where amber is dug, there is generally found *bitumen, petroleum, &c.* and again, where *bitumen* and *petroleum* are found, they are frequently accompany'd with Amber. The observations of *Sylvius Bacconi* on this head, deserve to be well consider'd; he says, 'that here and there in *Italy*, the *petroleum* is found in plenty, and also *succinum*; and that, particularly, on the strands near *Agrigento, Catanea, Leocata, &c.* In *Sicily*, there is found amber, and likewise much *petroleum*, even in open springs, when yet in all those Districts, there are found no firs, nor any other resinous trees: And wherever Amber is found, he makes no doubt but, upon further digging, we shall discover *bitumen, sea-coal, naphta, &c.*' This fossile Amber has been observ'd in *Bohemia* by *Balbin*; (a) in *Moravia* by *Hertodt*; (b) in the *Marck* and *Saxony*, particularly at *Wittenberg*, by the authors of the *Miscel. Cur.* (c) and in many other districts by *Hartman* (d). That *Silesia* is stored with it, appears from the pieces of Amber frequently found, especially on the *Venus mount* near *Riemberg*, and other places. On the *Kintzel-hill*, there was discover'd a few years ago, a matter, in colour, not unlike polish'd horn, encompass'd with a crust of a cinnamon colour, both of which, being flung on live coals, diffused a smell not to be distinguish'd from that of Amber.

The greatest
Magazine of am-
ber in *Prussia*.

The most compleat and valuable magazines of Amber, are found in several parts of *Prussia*, particularly in *Samland*, where it is fish'd up in stormy weather with nets. The coast is ranged along with steep hills, out of which now, but not in ancient times, the amber is dug in full perfection, tho'

(a) Misc. Regn. Boh. Dec. I. l. 1. c. 50. p. 115. (b) Tartaro-Mast. P. I. c. 5. p. 30.
(c) Misc. Nat. Cur. Dec. I. An. IX. & X. p. 102. & 223. (d) Hartman de Succino, c. 1. &c.

tho' with considerable danger to the workmen, as those hills, consisting meerly of sand, are very liable to fall in when undermined. The Amber veins are of three different sorts, the one consists of a blueish clay; the second of sand, and the third apparently of wood: The last deserves well to be consider'd, as not having the nature of a vegetable wood, but that of a fossile *bitumen*, being turfy withal, and which, when set on fire, will not only smell of salt-peter, vitriol and brimstone, but likewise of an agreeable gum or rosin, of all which however, the brimstone is prevalent; for these wood-veins are throughout garnish'd and blended with green transparent vitriol; the wood itself is of a dark brown colour, and, in other respects, much resembles common wood, as well the grain as knobs, except that it is more brittle: It is of a vitriolic taste, acid and astringent; being once set a fire, it will melt and consume, leaving behind it a reddish powder or calx, which makes a bright brick-red colour; it has no taste, except that it is still somewhat astringent: This wood is of a bituminous or a turfy nature, and *Hartman* says, that the soil in *Prussia* is very bituminous: This *bitumen* is of various sorts, but for the generality it is either hard or fluid: From the latter *Hartman* derives the origin of the *Succinum*, and with *Boccone* takes it to be nothing else than a *petroleum*, condens'd and indurated by sea-water, which, in its fluid consistence thro' the subterraneous veins, runs into the sea, and is by the sea-salt comping'd into hard pieces, tho' it cannot be denied, that between the fossile Amber, and the marine or sea-amber, there is some difference. *Hellwing*, concerning the *matrice succini bituminosa*, writes thus: 'When I visited the promontories of the *Baltic* ocean, in order to search as well for sea-plants as fossils, I enter'd the mines, where amber was dug, on purpose to see whether I might arrive at a more intimate knowledge of its nature, and the generation of it; and I found that it lay in certain *strata*; first there is on the surface a yellow *stratum*, in the broken sides of the mountains, next the sea-shore, extended lengthwise, consisting of small flints, and about an inch thick: Under this is a second *stratum* externally black, and of a turfy substance, which abounds with a fossile bituminous wood, to which vitriol either adheres, or is contain'd in it, and is often observ'd to spring or flower out of it, so that pieces of the purest vitriol are sometimes obtain'd from it. These *strata* are also furnish'd with nitrous and sulphureous particles, which are likewise scatter'd over this bituminous wood, as is evident not only from its colour, taste and smell, but from its sudden inflammability, and evaporation by fire. 'Tis observable, that the *strata* wherein amber is found, are blended more or less with a gravelly matter, so that a lump of it which may be found in the turfy *stratum*, and generally near this bituminous wood, as its matrix, is always involv'd in gravel, and a bituminous earth, and is so very moist and friable before it hardens in the air, that it must be tenderly handled. In short, where-

Hellwing's enquiry into the nature of amber.

‘ ever amber is found, this fossile wood, and bituminous earth, a gravelly matter, vitriol, nitre and sulphur, are found also. But here I must be understood to speak of the fossile amber, such as is taken from the mountains adjoining to the *Baltic* sea: For that which is found on the beach, being thrown up by the waves, and harden’d in the ocean, is generally involv’d in sea weed, and is never accompany’d with the bituminous wood, or any other appendage: So that it may be readily collected from this enquiry, that the matter of amber seems to be contain’d in a bituminous wood, which has been bury’d, as it were, in these mountains by the flood, or some subsequent inundation, and which, in progress of time, became impregnated with this *Prussian bitumen*. This may give some hint to the curious, how flies, and such other bodies come to be involv’d in amber, especially as the like insects are frequently observ’d in these *strata*. I also saw a piece of jet of the size of a fist, taken from the same veins.’

All this confirms what Mr. *Hartman* has propos’d in his *Historia Succini*, concerning the origin and growth of amber.

A cheap and new Hygroscope; by M. D. Johrenius. Taken from the Acta Berolinensia.

Translated from the LATIN.

YOU will possibly be surpriz’d when I communicate my new Hygroscope to you, as the cheapness and simplicity of it may render it liable to contempt at first; but you will not wonder at my commending a thing so seemingly trivial, when you are acquainted with its admirable use and properties. ’Tis, in short, the seed of *Geranium* or Cranebill, of which plant there are reckoned above fourscore *species*, which all agree in this point, that they have a rosaceous flower, whose *pistill* ends in a crooked or beak-formed seed-vessel, divided lengthways into five creases, to which as many *capsulæ* adhære, terminating in a long tail; which *capsulæ*, being separated by maturity from the stile or column to which they adhered, are wreathed, or spiral, from the *basis* to the point. They generally contain an oblong seed. See *Tournefort’s* botanical institutions, p. 266. But all the *species* of *Geranium* are not so proper to construct a hygroscope, tho’ all their *capsulæ* are more or less affected by humidity. For in some of the kinds they are only simply curv’d from the *basis* to the point, as in the 9th figure of Plate I. which are useless for the purpose: But others are so disposed, that when they are ripe, they are wreath’d and controverted spirally, as we see in the second figure, and those are to be preserved for hygrosopes: tho’ even of those, some ought to be preferr’d
and

and selected. The seeds of the lesser and trailing *Geranium*, with a hemlock leaf, (see *Casper Baubin Pin* p. 319.) discover the quickest sensation of any alterations in the air; but they are too small and slender, to have their wreathings or volutions very easily discovered by the eye. The broad-leaved *geranium* of *Casper Baubin Pin*, p. 319. has large well-form'd *capsulae* or Beaks, above a span long, distinguished with remarkable volutions; but from their size and grossness, their sensation is more obtuse than we could wish: we should therefore prefer seeds of a middle size, provided with beaks or points, such as are produced by the musked hemlock-leaved cranesbill of *Casper Baubin Pin*, p. 319. which *Remb. Dodonæus Pemptad*, p. 63 calls the supine or trailing *Geranium*; and *Lobelius*, in his history of remarkable plants, p. 376, calls the *myrrhida* of *Pliny*, and the *cranesbill* or *musked needle*.

It is a fair Plant, fastened by a small root, having purplish hairy stalks, and trailing on the ground, with many leaves on one stalk, disposed on each side, after the manner of *tansey*, thin, very much indented, somewhat hairy, which are spread on the ground, without their stalks, and smell of musk, especially if bruised between the fingers. There generally appear six or seven flowers about the top, on a long stalk, being small, with fine leaves, either white or inclining to red, which are succeeded in their season, by crooked or beak-form'd seed-vessels, of two or three Inches in length, brown, and rough or hairy. It is cultivated in Gardens.

The *Geranium* described.

To obtain then a very exquisite Hygroscope, you are only to graduate, as you please, a small circle made of any convenient matter, or rather a convex body which is better, and fix within it a single *capsula* or seed-case of our *Geranium*. A convex body is preferable, because the beak of the seed-bag being extended from much humidity, does not continue parallel to the horizon, but as it stops might touch a plain surface, and be interrupted in its motion. This being done, you will observe this exquisite Hygroscope to wheel about so readily, with an augmentation of drought, as to effect nine or ten volutions, and to revolve and run back again so sensibly, at an increase of the moisture, that upon the affusion of a drop of water it will scarcely retain a volution or two. But no degree of dryness will ever contract it so far, as to make the extremity or beak wreathed like its lower part, which beak being always somewhat extended, performs the office of an *index*: so that the number of the wreaths, or spiral lines, in the lower part of the *capsula* or seed-case, will discover how many entire circles the *Index* has made: as the *index* will also demonstrate that part of the graduated circle, which it has attained in its last motion. If, therefore, you will divide the circle into 24 degrees, and the hygroscope recover only six wreaths or volutions, you will clearly perceive 144 degrees of humidity. It is in fact so exquisitely sensible, that the *index* may be observed in continual motion, one while going round, and again revolving,

The manner of constructing this Hygroscope.

revolving, according to the action of the clouds in the atmosphere, as the obscurity of the sun from an interposing one, immediately produces a revolution of the feed. Thus even the wind might be examined, whether it was introductive of moisture, and of what degree. For as the Hygroscope has not an artificial *Index*, there is no danger of its being blown down, and its surface is too minute to be torn, or to be disturbed in its motion, by the most violent wind: but it rather sometimes, against the course of it, contracts or unfolds itself. A gentle breathing of the mouth affects the Hygroscope some degrees, and the different temperament of chambers may be evidently ascertained by its motion; nay, which entirely elucidates its acute sensation, the very vapours transpiring from a human body are sufficient to affect it, if the *Index* be apply'd near enough: from which the just preference of this Hygroscope to all former ones is self manifest. And if we regard its simplicity, 'tis impossible to think of any *apparatus* so plain and easily attainable, as the herb, producing this feed, is of no difficult culture, but, when once planted, continues spontaneously from deciduous seeds. It has the farther advantage of being portable, without which quality, one of the greatest and most general uses of a Hygroscope, which is to ascertain the temperament of different places, must be wanting. The rays of the sun do it no injury, nor have we any occasion to preserve it very curiously from dust, straws or the like, since it may be securely exposed to the open air. Besides, we are not troubled with the laborious constructions we see in other Hygroscopes, to determine how many circles they have accomplished in their motion; but as the spires it affects, may be always reckoned, our information is continual, and without defect.

Liabie to some
defects.

Yet, to dissemble nothing, I must acknowledge, that the perfection of our machine is impaired by its small durability, since it seldom lasts more than one, or at the most two years. And yet this defect is common to other Hygroscopes, which in a little time loose the faculty of discovering the dryness or humidity of the air. If, therefore, one or two of the former Hygroscopes be preferable to this for duration, that difference is rather inconsiderable than much; especially when we consider, that we have annually a sufficient quantity of these seeds, and there is but little difficulty in fixing a fresh one in the place of the other. I would advise you however, for the longer preservation of the seeds you shall select, to keep them in a cellar or some moist place. It must be allowed too, that we can say but little of the strength of our machine, since it cannot sustain the least collision with a hard body, but is immediately destroyed by it. Therefore, if a Physician or any other curious person, should incline to carry one in his pocket, let him provide a case like a watch-case, whose bottom may be distinguished into degrees; it may be defended a-top with a glass, as that is, but the rim should be artificially perforated, that there may be
a free

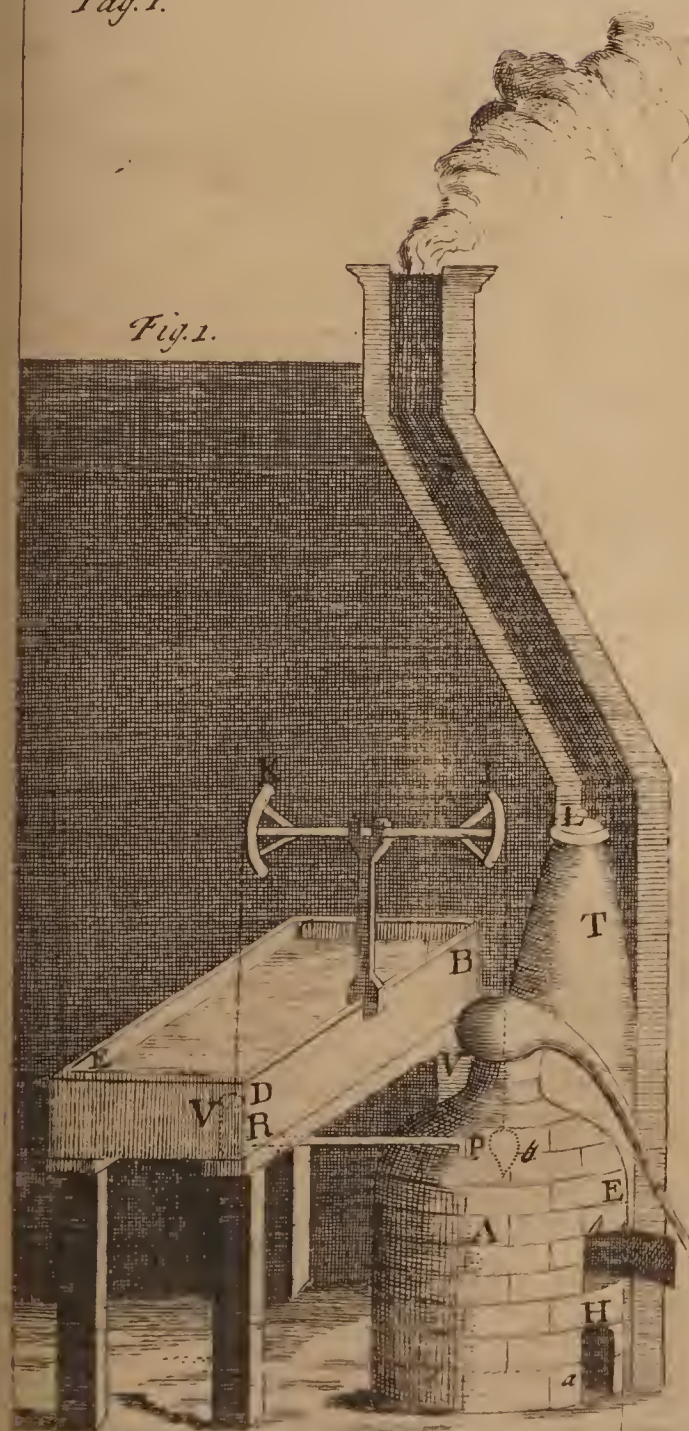


Fig. 10.



Fig. 9. p. 21.



Fig. 4. p. 4.

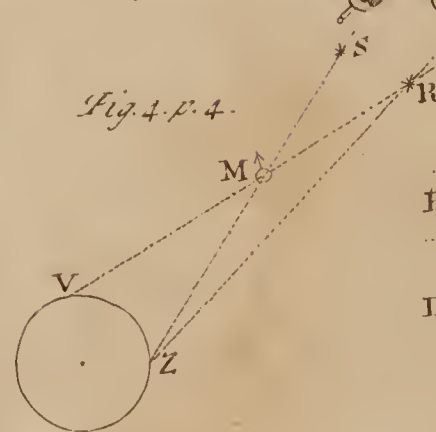


Fig. 12.



Fig. 6. p. 7.



Fig. 5. p. 5.

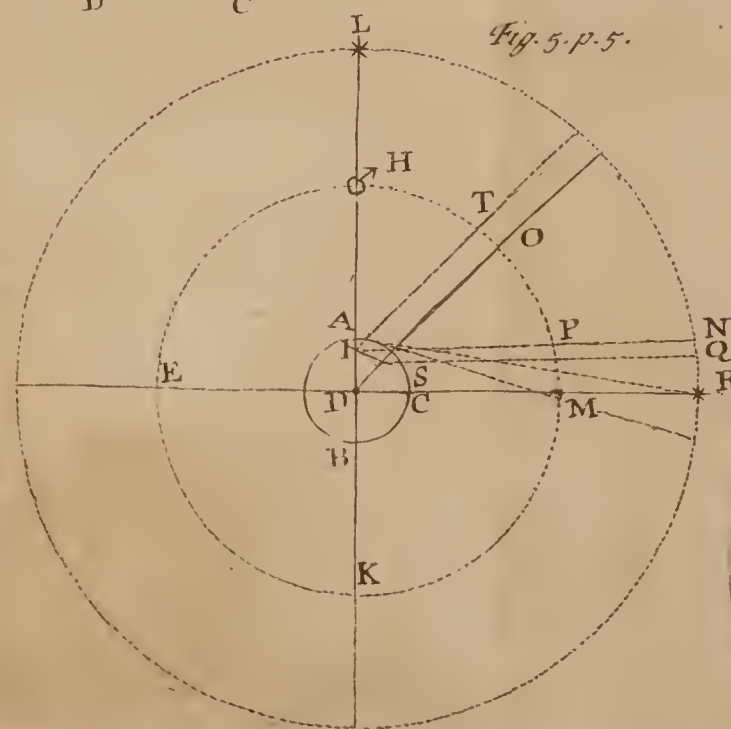


Fig. 3.



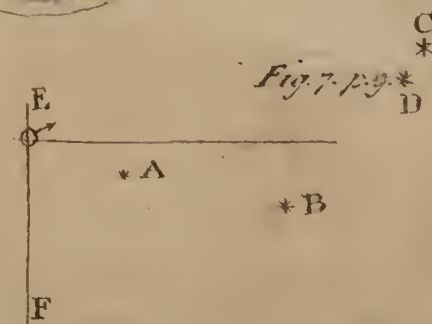
Fig. 8. p. 12.



Fig. 11. p. 21.



Fig. 7. p. 9.



a free afflux of air. And this method will sufficiently guard against the slender texture of it.

A third, and the last objection I know of, may arise from those who are dim thro' age, or whose eyes are so conformed, as to discern small objects, not without some trouble, and by the mediation of spectacles. For the benefit of such I have drawn the figure of a Hygroscope, which may serve as a model, and by which means an optic *lens* may be commodiously apply'd, to assist the sight. Thus in fig. 12. you may see a representation of a hexagonal body, with a surface somewhat convex, on which a graduated circle is described, containing in the centre a seed-vessel of the *Geranium*. At the corners of the *hexagon*, pillars are erected, which support its top: two of them have grooves, that the board inserted between them may be raised or depressed, for the convenience of sight, and as other occasions may require. This board has a hole, covered with an optic *lens*, of a convenient convexity, by the help of which the spiral lines or volutions may be easily reckoned. See fig. 9, 10, 11, and 12.

The great increase of the Norway Pea. From T. Bartholin. Act. Hafn. p. 66.

Translated from the LATIN.

THE extraordinary fecundity of the little soil among the rocks in the northern countries, assisted by the climate, is manifest, to the great satisfaction of the husbandmen. In the isles of *Ferœ* one grain of barley produces fifty stalks and ears, full, and of a plump grain, nature making amends for the scarcity of soil, by its exuberant produce. The thing is fact, I have seen and experienced it. I shall instance the *Norway* pea as a proof of it. A small pea, called the *pea of grace*, which was imported into *Europe* from *America*, is affirmed to produce near a hundred fold. But we have it attested by *Simon Paulus* a person of noted reputation and experience, in his *Botanics*, that in the garden of the noble *Klingenberg*, near *Hamburg*, one of these peas was productive of three hundred and twenty-four. This induced Mr. *Jac. Joach Kirsebom*, pastor of *Sognedahl* in *Norway*, to procure some of these peas from *Holland*, each of which produced, together, six hundred and ten, as he inform'd his father in a letter of *June 2. 1672*. The reason of fecundity in these places is probably owing to the great quantity of snow with which the earth is impregnated, and to the rays of the sun which may be collected with particular force and action among the rocks. And though the soil has little depth above the rocks, yet it appears sufficient for the reception and increase of the grain; for as *Theophrastus* says, in his first book of planting, chap.

chap. XXII. 'Corn indeed emits many roots of fibres, but they are superficial, rather than deep and perpendicular.'

A dissertation on the Anodyne Sulphur of Vitriol. By Dr. Godfrey Roater. Published at Leipfic. Ann. 1723.

Translated from the HIGH-DUTCH.

I N T R O D U C T I O N.

Necessary means
for improving
Chymistry.

IF there be any one thing, which is highly necessary for the farther improving and promoting the art of chymistry, it is certainly, the accurately weighing, and circumspectly imitating the discoveries, which those, who have gone before us, have made in the art: For, the bounds of this noble science being so extensive and wide, it is scarce possible for any person in his own experience and observation to examine every thing by himself. Whence it is of no small help in our inquiries to adapt the care and application of others upon the same subject: and for this end it were to be wished, that the elder writers, in communicating their discoveries to posterity, had thought fit to use a greater degree of plainness and openness, than they are generally found to have done: but in regard, they pretended such a procedure not allowable, or rather, not falling in with their inclination, they have scarce left us any thing more than the bare names of their discoveries: and yet even these should not be entirely neglected, in regard the title of the discovery does sometimes contain more under it, than the discovery itself: and certainly might help to throw a greater degree of light on the art; but for jealousy and a fond desire in the moderns of rivalling the ancients; as that some, discouraged by the tediousness of processes, have neglected or overlooked circumstances, that were notwithstanding to be regarded, as the authors themselves have hinted; and rather taking into consideration the colour, taste, or some other trifling circumstances only, it has generally happened, that they have embraced the shadow instead of the substance. Others, not to appear ignorant of any one thing, obtrude upon us, with great care, the fictions, instead of the real productions, handed down from venerable antiquity: whereby it might necessarily happen, that the promised and wished for effect coming to fail, there unavoidably a doubt arises; whether the ancient chymists have not sometimes published falsehoods for truths, or bare empty speculations, instead of genuine and certain experiments: or whether, their successors have faithfully trod in their steps, or rather, over-eager in shortning the road, have swerved into the by-paths of

of error; as *Stahl* in his *Zymotechny* or art of fermentation, not without reason, suspects, when he speaks to this purpose: ‘We, says he, are hindred in our most successful progress in chymistry thro’ our impatience; not being able to bear the tediousness of a long digestion, a long trituration, a repeated cohobation, repeated imbibition, and a still oftener repeated deliquation, or running *per deliquium* in a moist air.’ And to our purpose, the name of an *anodyne sulphur of vitriol*, was a thing in great repute amongst the elder chymists, particularly *Paracelsus*; but amongst the moderns, scarce any thing to be found, deserving the commendations given this Sulphur by that author: so that many have ranged it amongst the dreams and chimeras of chymists. We have therefore thought it of service, to examine, whether such an anodyne Sulphur be procurable from vitriol; by what method it may be procured, and what the virtues that are to be expected from it.

CHAP. I.

Whether there really be an anodyne Sulphur in vitriol?

THIS query might seem unnecessary and superfluous, so were but the regard paid to the authority of others sufficient to establish the truth of any proposition. For, we might here bring in the testimony of *Paracelsus* (a), the grand monarch in chymistry, as he is pleased to stile himself; who not only expressly maintains the existence of such a Sulphur in vitriol, but extols its virtue in a very high degree. As this is the principal passage, and the very first that makes mention of this matter, it deserves to be here alledged, tho’ somewhat with the longest; it runs thus: ‘Now know, from the embryonated Sulphur in vitriol and the like, what species of vitriol there be; as the salts, that give a highly surprising Sulphur, if the animated bodies are separated from the embryonated ones, as from salt, sal-gem, the several species of alum, from vitriol, &c. But now I shall give you a short rule in general; viz. That all Sulphurs from vitriolated salts, are narcotic, anodyne, and soporiferous; yet so mild as to go off without producing any of the bad effects of opiates from poppies, mandrakes, henbane: and know of this sulphur, that amongst all those from vitriol, it is in itself fix’d.’ We might here also advance the testimony of *Sylvius* (b) in his praxis, who thus speaks of the matter: ‘what several people relate about the anodyne, or rather alleviating sulphur of vitriol, sufficiently shews, that this Sulphur is a thing unknown to most people; tho’ never enough to be commended on account of its surprising effects, which I myself have experienced.’ And

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§. 32.

(a) De Reb. Nat. T. I. L. 1. c. 7. p. 1045. (b) L. II. c. 25. §. 17.

§. 32. he advises, the seeking after this anodyne Sulphur of vitriol, and when found, the holding it for the greatest arcanum. We might even adduce all the chymical physicians of the latter ages, were thus a lover of truth to be satisfied, or one of a contrary opinion, thereby to be convinced. But authorities are so far from determining this dispute, that on the contrary, it is easy to adduce a *Detbarding*, a *Ludovici*, a *Jüngken*, a *Barkbusen*, and many others, who either entirely deny such anodyne sulphur in vitriol, or depreciate much its virtues and effects: And thus authority would stand opposed to authority.

2. This dispute can scarcely be determined without a previous knowledge of the nature of vitriol, and an examination of its essential parts: and by a chymical analysis it appears, to be compounded of four parts, viz. (1.) An insipid phlegm or water. (2.) An acid spirit. (3.) Metallic, coppery and irony particles. (4.) A mineral earth, which hitherto has acquired no metallic nature; as *George Detbarding* (a) has shewn at large.

3. Now from this it easily appears of itself, that a vitriol is an acid spirit, entirely similar to the acid of Sulphur; but of the inflammable principle or resinous substance, that easily takes fire, and constitutes the other portion of what is properly called Sulphur, is with difficulty any trace found in vitriol. To this add, that sulphurs, if not very accurately combined with alkali salts, are not so much as once affected by aqueous menstruums, not to mention, quite dissolved; in which notwithstanding the entire substance of vitriol comes to be dissolved; nay, where-with vitriol itself is extracted out of its ore.

4. On which account, if any one would undertake to prepare from vitriol a genuine inflammable Sulphur, he attempts a bootless labour, and shall by no art or skill procure from it what it really has not; unless instead of the vitriol he take its ore, which we readily allow generally to abound with inflammable sulphur; especially if it has not hitherto undergone the action of the fire, or been long exposed to the air. And possibly hither refer the words of *Paracelsus*; whereby he assures, that such embryonated sulphurs, as he calls them, are not to be looked for in the animated body or kernel itself, but in the shell, enveloping this kernel: but his mentioning, that this anodyne Sulphur of vitriol is in its nature fixed or can abide the fire, destroys any such conjecture; as no such fixedness can with certainty be ascribed to any inflammable sulphur.

5. However 'tis no unusual thing with chymists to call the more subtile and most tinged particles of metals or minerals, tho' not inflammable, Sulphur; as in this sense mention is often made of the sulphur of iron, copper or antimony: but vitriol greatly abounds with such particles, that not
only

(a) Chymische probier-öfen. p. 228.

only affect the sight with the most beautiful variety of colours, but besides, are so subtile as to communicâte their tint to the hardest glass, as experience confirms, and *Chr. Langius* shews (a).

6. Finally, as to the anodyne virtue; *Paracelsus* himself distinguishes the virtue of this sulphur from the effects of opium, henbane, mandkrake, and other narcotic vegetables: whence it would be doing our author an injustice, to make him confound these virtues together; 'tis enough, we can shew something in vitriol, which is capable, by a gentle force, to still the motion of the irritated nerves; though possibly it may operate in a different manner from opium, and not so quick, and in so small a dose.

7. And thus, if one was to chuse among the above-mentioned parts of sulphur; the two first, namely, the phlegm and spirit must without hesitation be excluded: for it is evident, that to these the name of a sulphur cannot agree, as being what rather manifests a firm, close, and not a volatile, a tinged and not a transparent substance. That we also exclude the metallic particles, tho' possessed of very beautiful tints or colours, is owing to the anodyne effect we look for here; as these, especially the particles of copper, have a stimulating and emetic, rather than an anodyne and calming virtue: and therefore, there only remains the mineral earth. Now that such is capable by a gentle force to cause soft, easy contractions, and lay the tumult of over-stimulated nerves and feverish motions, the bare instance of the sweet or balsamic earth of vitriol, as it is called by some, is a proof. 'Tis certain, this last is of eminent service in asswaging vomitings, looseness, hypercatharses and other preternatural fluxes, when properly prepared, and freed from the adhering acid, coppery particles, though still overstocked with many gross earthy impurities, and far from being exalted to a proper degree of subtilty.

C H A P. II.

The method of preparing the anodyne Sulphur from vitriol.

1. **A**S *Paracelsus* himself, who, so far as we know, first made mention of this Sulphur, has concealed its preparation; it must necessarily have happened that his followers should have entertained different opinions on that head: so that I am apt to believe, there are scarce more ways of preparing the *aurum potabile*, than there are of preparing this anodyne Sulphur of vitriol: yet they may be principally reduced to three classes, some proceeding by way of precipitation; others of sublimation; and others again of extraction and distillation.

2. The most usual method, and of which *Basil Valentine* makes mention, is that of precipitation: namely, the vitriol is dissolved in com-

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(a) Miscel. p. 86.

mon water, into which is then dropped oil of tartar *per deliquium*, or a solution of potash, or any lixivium, or even an urinous spirit; and there falls to the bottom a powder, which indeed at first shews greenish, but afterwards, whenedulcorated and dried, of a brown colour, and usually stiled, tho' undeservedly, an Anodyne Sulphur. In this operation 'tis remarkable, that the parts thus thrown down, differ in kind; as that those precipitated at first are of a far darker green than those at last, as having a much brighter colour, till at last they become quite whitish: and this difference of the precipitated parts not only in colour, but also in effect, is also observable in the precipitation of Sulphur from antimony (*a*). Next remains to be observed, that when this precipitation is performed with the spirit of urine, the business succeeds with difficulty in a vitriol of a coppery nature, as is the cyprian. For so far is this solution of vitriol, by dropping in an urinous spirit, from becoming turbid, that rather is its colour generally heightened, nay become sapphirine (*b*). But common vitriol, as that of *Geyerberg*, which generally holds both iron and copper, takes precipitation with ease: but when the precipitated magma together with the liquor floating a-top, is exposed to a gentle heat or the sun's rays, the liquor hitherto pale, does thence gain, in the course of a few weeks, a deep blue colour; plainly to shew, that copper has a peculiar sympathy with the urinous salts; so that the coppery particles, though once let go, are again attacked and dissolved by it.

3. Some people, in order to heighten the virtue of this vitriolic precipitate, are wont to employ, instead of the simple alkali, an alkali impregnated with the sulphur of antimony, or the lixivium of the scoræ of the regulus of antimony; the precipitating powder isedulcorated, dried and calcined in the strongest reverberating fire for 12 hours, in order to dissipate the volatile, emetic, antimonial parts, and only retain the more fixed and diaphoretic ones, together with the anodyne sulphur of the vitriol.

4. Others again endeavour to enrich it, by means of sublimation, distillation and a second precipitation, with a nobler set of virtues. The method is laid down by *Kessler* (*c*), *Hartman* (*d*), and *König* (*e*): namely, the supposed Anodyne Sulphur of the vitriol, precipitated as above, and freed from all its salt by means of common water, is sublimed; the sublimate mixt with half tartar, or according to *Hartman*, an equal quantity of salt of vitriol, and by means of a retort distilled into a red oil, which is a-new precipitated by pouring vinegar thereon, and then extracted with spirit of wine.

5. *Basil*

(*a*) Etmul. in Colleg. Pharm. in Schroder. S. III. c. 19. p. 889. (*b*) Stiffer in Act. Chym. Specim. II. (*c*) Cent. 3. n. 66. (*d*) Prax. Chymiatr. p. 75. (*e*) Regn. Miner. Sect. IV. c. V. n. 7. p. 149.

5. *Basil Valentine's Encheirisis* must not here be omitted; which consists in precipitating this Sulphur with alcali; extracting with juniper oil, and lastly with spirit of wine (a). With this coincides *Robelius's* method, which, without the addition of oil, shews how to extract with spirit of wine the sulphur of the vitriol, precipitated by an alcali; and is recommended by *Etmüller* (b).

6. The precipitation may also happen without addition of an alcali salt; in the same manner as the metallic solutions made by means of aqua fortis, upon throwing in a body, that they more readily dissolve; such in particular are iron and zink; when the metallic particles, they had before drank up, come directly again to fall out of their pores: in this manner *Pharam. Rbumeilius* (c) prepares his anodyne Sulphur from vitriol; namely, suffering the solution of the vitriol to boil gently over the fire, he throws into it tender iron plates, therein to continue for about an hour. And thus as he supposes, will the anodyne Sulphur be extracted out of the iron plates, which is then to be scrap'd off, wash'd with hot water, dried, and kept for use. Yet to speak the truth, instead of an anodyne Sulphur, we rather thus procure bare coppery, emetic particles.

7. But those who hope by means of sublimation to reach their end, have, besides *Basil Valentine*, *Helmont* himself for their guide: and such take either vitriol, which is gently calcined in the sun, or even the sulphur of vitriol, which is precipitated with the spirit of sal-armoniac; or they employ the edulcorated caput mortuum of vitriol, which they mix with an equal quantity or with two parts of sal-armoniac, and sublime it with a strong fire; the sublimate they again free from all its sal-armoniac with common water, and afterwards extract it with distilled vinegar, and lastly with spirit of wine: Or they mix it, without separating the sal-ammoniac, with the sea-salt extracted out of the caput mortuum, remaining after distilling the spirit of salt.

8. Those, who would by a kind of extraction or distillation, perform the thing, go in quest of several menstruums; amongst which common water offers the first; in regard vitriol is thereby boiled out of its ore; and the solution beginning to grow thick, there usually arises upon the liquor a pellicle or fat cremor, that must be removed with a broad ladle, or by filtration; this *Agricola* (d) calls the soul of vitriol; and afterwards made by him, by means of the sweet spirit of mercury, into an essence or tincture. But *Mimmerus*, a celebrated chymist of *Silesia*, has a-new separated therefrom, by pouring on water, a fatty substance, which in a few grains he administered to patients, as the mildest and most efficacious anodyne,

9. In

(a) Schlufs-reden. c. 8. p. 375. (b) Col'. Pharmac. in Schrod. Sect. III. c. 27. p. 923.
(c) Basil. chym. n. 20. p. 178: (d) Comment. in Popp. p. 338. and p. 443.

9. In the next place, we are to mention distilled vinegar, peculiarly employ'd by *Quercetanus*, *Hartman*, and *Kesler*: Take and mix Hungary vitriol with half the quantity of the purest iron-filings; when well mixed and worked up together by a continued rubbing, there is some distilled vinegar poured thereon, to the height of a finger's breadth above it; then it is boiled in to dryness, after which the fire is so heightened, till the whole in some measure become red. (But the better way would be to calcine the vitriol *per se*, in an hermetically sealed vial, to the highest degree of redness, after the method of *Kunckel*, *Agricola*, *Geisler* and others.) Then the mass is taken out, well rubb'd, and fresh vinegar poured thereon, to the height of 3 or 4 inches above it; after which by means of digestion the tincture is extracted, the tinged vinegar decanted and filtrated, and oil of tartar per deliquium dropped thereon: and there falls down a narcotic sulphur, as they call it, which being well edulcorated, dried, and along with some aromatic extracts mixed with the magistery of pearls and other things, is *Hartman's* laudanum without opium (a).

10. Next to vinegar, we justly rank spirit of wine, which being a number of times abstracted from vitriol, thence acquires a notable flavour, like malvesy or *Spanish* wine, and is also impregnated with an anodyne virtue: whence it appeared to *Angelus Sala*, the most adapted for this purpose; who frankly owns, that he could not observe the anodyne virtue, he in vain looked for in several things prepared from vitriol, in any one thing, in a more observable and certain manner, than in this extract, prepared with spirit of wine. Take vitriol, which has gently calcined in the sun, or is well dried in a warm room, and put it into a glass vessel, wherein there is no wet: to two pounds of vitriol pour on 30 ounces of highly rectified spirit of wine, (for he ingenuously hints that the least phlegm in the spirit, or wet in the glass, wherein the vitriol is put, will dissolve, and not extract it, whereby a nauseous flavour is communicated to the medicine) and then the vessel, after stopping it well, is for a month together to stand in horse-dung: after which the spirit of wine, which now has gained a peculiar, elegant and strong flavour, by gently tilting the vessel, is parted from the feces, and abstracted in balneo mariæ, till only an oleaginous liquor remain behind (b).

11. On this very bottom seems to rest the cephalic spirit of the late *Chr. Langius*, which *M. Waitz*, Burgomaster and physician at *Gotha*, in his epistles, entitled, *reflections on alchymy* (b), shews, how to make in a compendious, neat and elegant manner: namely, the caput mortuum of vitriol is put into a stone body, having a small tube, and urged with a strong fire, till all be of a thorough glow; then a little spirit of wine is dropped

(a) *Hartman. Prax. Chymiatr.* p. 13. *Kesleri Centur.* III. p. 67. (b) *Vid. Angel. Sala Anatom. Vitriol. Tr. I. c. 11. p. 272.* (c) *Bedencken von der Alchymie*, p. 42.

dropped in, which comes over the helm in form of a highly oleaginous spirit, and forces over along with it some of the more subtile mineral earth. Now that this last, and not any genuine sulphur is in this manner by means of spirit of wine extracted from vitriol, appears from the ruddy powder, that of itself settles in the spirit of wine, abstracted from calcined vitriol.

12. Farther, urinous spirits are here too not unserviceable: and thus was *Hartman* wont, out of vitriol, moistned with children's urine, to prepare his antepileptic spirit; which *Etmuller* (a) avers to be no mean preparation, and that the late Dr. *Michaelis* greatly used it; nay, makes mention of some epileptic patients, that by taking it have been freed from inveterate epilepsies; and this also *Agricola* (b) confirms by his testimony.

13. To wave these, and come to the phlegm and spirit of vitriol: In distilling vitriol, there at the very first comes off with the greatest degree of heat and force, a volatile spirit; so greatly esteem'd by *Paracelsus*, as generally to ascribe thereto the cure of the epilepsy; assuring, that what is commonly thrown away under the name of an useless spirit, is the noblest part; and that we are not to look for the cure of the falling-sickness in the fix'd oil of vitriol, but in its volatile parts: but that this volatile spirit of vitriol is no other than a part of the phlegm, impregnated with a few particles of the subtile mineral earth, appears from *Glauber's* remark (c); for he has observed, that after a red powder settles to the bottom, it turns to an insipid phlegm; an observation confirmed also by *Ludovici's* experience (d).

14. Nay *Glauber* promises himself a large quantity of this volatile spirit, upon mixing vitriol and iron-filings in equal quantity with half the quantity of salt-petre, and distilling with a strong fire in a retort (e). But it may easily be conjectured, that this large quantity of volatile spirit arises not so much from the vitriol as from the iron, which is laid hold on and dissolved by the spirit of nitre, forced out of the salt-petre by the vitriolic acid; for upon dissolving iron with spirit of nitre, or with aqua fortis, copious sulphureous fumes strike the nose: Nay another experiment of *Glauber* confirms the same thing; namely, when iron-filings by means of his secret ferment (which consists of common salt dissolved in water, and half the quantity of oil of vitriol) is dissolved, there also goes over a volatile, sulphureous, and highly penetrating spirit, which in like manner by means of rectification is changed into an insipid phlegm, and a reddish, highly fixed powder. (f).

15. But

(a) Colleg. Phar. in Schrod. p. 921. (b) Comment. in Pop. P. I. p. 320. (c) Philos. Offen. P. II. p. 13. (d) Pharmac. Mod. Sec. applic. p. 439. (e) Pharmac. Spag. P. II. p. 93. (f) Pharm. Spagyr. P. VI. c. 13.

15. But *Glauber* assures, the quantity, that in this manner is brought over along with the phlegm, is so small, that out of 10 pound of this spirit, tho' so penetrating, scarce a scruple of this red powder could be collected : whence here is needful repeated cohobation, were this phlegm any thing worth the while, as being the method employed by *Helmont* the son to ennoble it ; M. *Marci* (a) testifies, that in a desperate consumption, from a vomica in the lungs, it manifested an extraordinary strengthing virtue. Certain it is, the effects of repeated cohobation appear from the instance of common-water, which being distilled a number of times from vitriol, gains therefrom a penetrating, astringent, yet no disagreeable taste.

16. Yet herein shew the spirit and oil of vitriol (which last is no other than a more concentrated portion of the spirit) a far quicker and better effect ; especially when this latter is urged with a violent and continued fire, and the other only cohobated a number of times over its own salt, or only over the caput mortuum. This method *Agricola* employ'd ; namely, he takes the spirit, which as usual, is forced out of a well purified vitriol, and pours it on its own salt, extracted with common water out of the caput mortuum, and by repeated calcination, solution and coagulation, purified in the best manner possible ; and therein dissolves it by means of a long continued digestion ; the solution he separates from the impurities by decanting it off, and brings over again the spirit by distillation in a retort, pouring it back again on what remains behind, and this he repeats seven times, till it becomes a fatty well-flavour'd liquor. Finally, he pours again the abstracted spirit on the remainder in the retort, which, after a short course of digestion extracts a very beautiful red tincture ; the tinged spirit he again distills to dryness ; and from the remaining powder extracts the tincture with highly rectified spirit of wine, and again abstracts it by distillation (b).

17. That *Paracelsus* himself had also employ'd this method, and forced the sulphur out of the vitriol by means of its own spirit and repeated cohobation with the strongest degree of fire, appears from what he mentions of the preparation of the antepileptic spirit of vitriol (c).

18. But for the spirit and oil of vitriol, without so many tedious cohobations to bring over along with them in distillation something of the subtle mineral earth, and hold it included in their pores, chymists have devised several methods ; as also to set at liberty the Sulphur from the acid, which is not a little unfriendly to the nerves : And thus the first trials were made with spirit of wine, which they mixed with the spirit or oil of vitriol, and digested together for a long time, at last abstracted it again ; that in this manner the sulphur might settle to the bottom in digestion, or in distillation

(a) Phil. Vet. Rest. P. V. c. 9. (b) Agric. Comment. in Popp. P. I. p. 497. (c) T. I. p. 789.

distillation come over along with the spirit of wine. Whence were procured the distilled ætherial oils, far more adapted to blunt the sharp points of acids; and hence also *Bartholine*, as *Etmuller* testifies, attempts to do the business without wormwood-oil, *Maetsius* and *Margraff* with oil of turpentine: namely, taking half an ounce of oil of vitriol, and the same quantity of ætherial oil of turpentine; or, as *König* (*b*) will have it, six times that quantity; viz. six half ounces, mixing the whole together in a pretty tall body, and often shaking the glass, till at last, after a violent effervescence and incalcescence, the whole turns to a red liquor, smelling like opium. This liquor is diluted with pure water, and boiled a little; and the turpentine in part along with the water evaporates, and in part floats thereon, a thick balsam, like pitch, settling to the bottom; which may be extracted with spirit of wine, and after abstraction evaporated to the consistence of pills (*c*). In this process 'tis worth observing, that by its means a genuine inflammable sulphur is procured; which yet, as *Barchuysen* (*d*) truly hints, takes its rise, not so much from the vitriol as from the oil of turpentine, which unites with the vitriolic acid, and is coagulated thereby. Besides, it must needs happen, that the more subtile parts of our Sulphur, which is what is principally to be regarded, partly evaporates in the boiling, and partly remains behind in the mass of floating liquor.

19. Whence *Kessler's* method (*e*) is far better and more commodious, tho' not perfect in all points; wherefore we think it worth while to attempt the improving it. Namely, the vitriol is calcined yellow at first with a gentle fire, kept at the same pitch for a whole day together, so as not to exceed the heat of a summer's sun; afterwards the fire is gradually heightened and raised till the red oil come over, and thus the spirit be forced off. From the caput mortuum is extracted the salt, which is carefully purified, and thereon the spirit again poured, and set in horse-dung for fourteen days: After which, the spirit is again brought over with a strong fire in a retort, then in a cucurbit freed of its phlegm, till a dark brown liquor remain behind; which is set to crystallize in a cold place; and this so often repeated, till all the liquor shoot to transparent crystals. On these crystals the spirit or ætherial oil of turpentine is gradually dropped in a wide phial (not the spirit of vitriol as *Kessler* has it) till after a violent effervescence, the crystals are dissolved by the oil of turpentine, and changed to a highly red liquor. Then three times the quantity of highly rectified spirit of wine is added, and again abstracted by a gentle distillation; and the spirit that comes over carries along therewith the subtilest sulphur in form of a blood-red tincture; which may either be still repeatedly

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(a) Colleg. Pharm. p. 923. (b) Reg. Min. p. 149. (c) Vid. [Morley Collect Chym. Leyd. n. 532. p. 484. & König l. c. (d) Pyros. L. III. S. IV. c. 3. p. 306. (e) Cent. III. n. 65.

rectified with fresh spirit of wine, or circulated with rasped genuine unicorn, and thus be used as the greatest cephalic, antepileptic, antipodagric, &c.

20. Yet there remains a more secret method, without adding any one thing foreign or adventitious, of separating from the spirit of vitriol the noblest sulphur; of which we find observable traces in *Basil Valentine*; but as this method is known to a few, and besides, beset with many difficulties, we shall no farther insist thereon.

21. As the limits we have set ourselves will not suffer us to consider at large which of the above methods is best, it may suffice here to alledge, that the anodyne virtue to be expected from vitriol, is to be sought for in its mineral earth, but in its more subtle parts; and consequently must be, with care, freed not only from the adhering acid, but also the coarse, earthy, especially the coppery metallic particles. For so long as it is entangled with acid particles, it proves prejudicial to the nerves; and when loaded with coarse earthy particles, cannot be sufficiently penetrating, or commodiously distributed in the body; and if still mixed with copper, there is hazard of its causing vomitings. When this is duly weighed, it will be no difficult matter to conjecture, which method of preparation is to be prefer'd. The method by precipitation with a lixivium or an urinous spirit; or that by sublimation, by means of sal ammoniac; or by extraction with distilled vinegar, to procure the anodyne sulphur of vitriol, will difficultly give it pure and subtle enough, and quite free of all copper, and all emetic virtue. Those advise best both for themselves and patients, who know how to separate it with common water or spirit of wine; or by its own phlegm and spirit bring it over by means of distillation, and again aptly set it at liberty from the acid.

C H A P. III.

Of the virtue and utility of the anodyne Sulphur of vitriol.

1. **A**S the life and health of our body solely consist in, are preserved and again recovered by motion; and as also by motion, namely, an unordinate and irregular sort, they are greatly annoyed, nay quite destroyed; 'tis certainly necessary, that the physician be furnished with two sorts of means, whereby not only to rouse up the low, weakly, and quite depressed motions, but also to lay, and to calm the more excessive or over-violent ones. For the former purpose, such active medicines, as stimulate the nerves; for the latter, such as assuage and still the irritations; in a word, such as are anodyne.

2. But

2. But in what manner these produce their effects, is not hitherto sufficiently known; though they seem to do it in a two-fold way; namely, by either gently relaxing or contracting the nerves and muscular fibres; for in both ways is their motion maintained; as appears evidently from the fibres of the muscles and the nerves that serve for voluntary motion; their effects directly ceasing, when either preternaturally relaxed, as in the palsy, or extraordinarily contracted, as in convulsions.

3. The former effect is produced by opiates; which these may accomplish, in regard they thin the blood and distend the arteries of the brain, and thus compress the beginning of the nerves, and intercept their motion; an opinion that of late is generally received: or they may produce the same effect, by dissipating the fluids and emptying the vessels; or in any other way to us hitherto unknown; yet several circumstances, observable in the operation of opiates, shew that they relax the nerves and muscular fibres; for instance, that peculiar lassitude, ensuing upon sleep, caused by opiates, as *Etmuller* (a) testifies; in like manner, that listlessness and drowsiness, common to those that exceed in the use of opium; farther, the manifest damage, caused by opiates in those that labour under a dropsy, cachexy, or flaccidity of the parts, or in persons quite weakened and exhausted by old age: as do also the anodyne effects, produced by mucilaginous and moderately oily matters, as milk, luke-warm water, and each warm moisture, that softens stiff and rigid parts.

4. The latter effect is to be expected from matters, that, with a mild force are capable of producing a gentle contraction, and strengthen the nerves and muscular fibres; thereby hindering their being easily incited to unordinate motions, by every slight stimulus; or the motions, after the removal of the irritating cause, being causelessly continued.

5. And in this number may also be ranked the Sulphur of vitriol: for we have above not only adduced the testimony of *Paracelsus*, that it manifests its anodyne virtue in a quite different manner from opiates; but also that of the celebrated *Sylvius*, who was not unacquainted therewith; affirming (b), that the narcotic effect of opium, and the calming virtue of the anodyne Sulphur of vitriol widely differ from each other; tho' he explains this difference somewhat otherwise.

6. But that this our opinion is not quite groundless; namely, the ascribing the virtues of this anodyne Sulphur of vitriol to its contractile force, will easily be granted by any one, that comes to examine by the taste barely; either the whole concrete of vitriol, or all its parts, or even all the preparations thereof; or if he but a little accurately consider the effects of the flowers of the hæmatites, which by *Etmuller's* testimony (c), is anodyne; or even the virtues of the other more moderate martial preparations, in hy-

F 2

pochondriac

(a) Coll. Pharmac. in Schrod. p. 712. (b) Prax. L. III. c. 26. §. 31. l. c. p. 804.

pochondriac, hysteric, and the like cases. It also appears, that from no other ground can the virtue of this spirit of vitriol, when tolerably impregnated with its Sulphur, against the epilepsy be derived; when we remark that a like efficacy in the like distemper may also be found in other gentle stimulants, as the *cortex chinæ*, *semen lycopedii*, and the prepared hard parts of beasts.

7. At least, it hence appears, that this vitriolic anodyne, in certain cases, is preferable to opiates; namely in such, where it appears, that opiates, either on the score of their force of resolving or in some measure weakening the nerves, are unadapted thereto; or on account of their transient effects prove insufficient for the purpose; for instance, in a flaccidity and weakness of the parts, in a dropsy and cachexy; as also in habitual distempers, as epilepsy, vertigo's, and the other chronical convulsions. For our mineral anodyne not only strengthens the nerves, far from weakening them, but besides consists of more fixed particles, that are not so easily dissipated and scattered about in the air: and therefore the encomiums *Langius* (a) makes on his cephalic spirit, are not to be regarded as extravagant; when he assures, that it most effectually cures the apoplexy, head-ach, vertigo, and other cephalic disorders; strengthens all the bowels, and happily roots out cachexy and dropsy.

8. But to hasten to a conclusion; opium may retain its commendation; and we not inconsiderately deprive it of the great esteem it is held in by the unanimous consent of modern physicians. Yet at least our Sulphur may claim the next place, and may either be taken sometimes instead of opium, or used along with it, that the resolving force of opium may be tempered by its contracting virtue; as the mixture of opiates and anodynes with aromatic and volatile salts is otherwise not unsuccessfully employed, and greatly cried up.

C O R O L L A R I E S.

1. **F**ROM antimony may a genuine, inflammable Sulphur be procured; and not first produced therefrom by the addition of acids, but extracted by a simple separation.

2. 'Tho' this Sulphur of antimony differ little in inflammability and external appearance from the common sort; yet we may conclude, that in internal texture and the mixtion of its particles, and consequently in its virtues, it is really different from it; as we sometimes observe, that, when dissolved in oil of turpentine, and after cooling settled to the bottom, it then concretes into the form of long *Antimonial striæ*.

3. A vitriol may be produced from all metals, and from every thing having an affinity with metals; yet with more difficulty from gold, and
most

(a) Miscell. p. 85. Id. Pathol. Anim. p. 106, and 404.

of GERMANY, &c.

most of all from antimony. Yet this last, may, by means of a peculiar encheiresis be brought to transparent crystals, resembling nitre.

4. There are also volatile metallic salts.

5. Every spirit of vitriol is not acid; but there is a vitriol that yields no acid spirit.

6. That there are also insipid menstruums of metals, at least, not acid, the instance of common water shews.

7. The waters wherein glowing metals are repeatedly quenched, or wherein they have boiled for some time, or have been but barely plung'd, do thence acquire observable virtues, not ascribable to bare irradiation, but to some certain particles imparted.

8. Mercury does peculiarly and with ease communicate itself thereto; water receiving into its pores, no small portion thereof, nay carrying it along with it self over the helm.

9. Mercury seems to be nothing other than an inspissated mineral water; whence it may also, by means of a peculiar encheiresis, be re-converted into a bright clear water.

10. That there is in Mercury an anodyne virtue, not only does reason, but experience itself, demonstrate.

The skeleton of a Swan. By Dr. Geo. Wolfgang Wedel. Misc. Curios. Ann. 2. Obs. 12.

WE are sufficiently apt to admire the sporting and variety of nature in animal and vegetable bodies, even where her productions seem erroneous, though we are ignorant of many of her curious, continual, and oeconomical elaborations. The *Sternum* or breast-bone of a Swan is no bad instance of this; being hollowed, in the upper part, like an arch, for the reception of the wind-pipe, which, after its admission, within it, recurves upwards, and terminates within the *thorax*. There is no doubt, but many other creatures, which have seldom been dissected, must furnish us with many instances of singular contrivance and mechanism, distinct from the ordinary appearances of others. Thus we see the lower jaw-bone of the badger so firmly and accurately inserted within the upper, that 'tis impossible it can be dislocated, being secured like a door on its hinges; so that after death it remains equally fast, without the connexion of any Ligament, and is moveable upwards and downwards. The better to demonstrate the contrivance of the *sternum* of the Swan, I have sent the Skeleton of one, which has been engraved since by order of the academy, to manifest their acceptance and approbation of our good intentions. See fig. 1. Plate II.

EXPLI-

LITERARY MEMOIRS

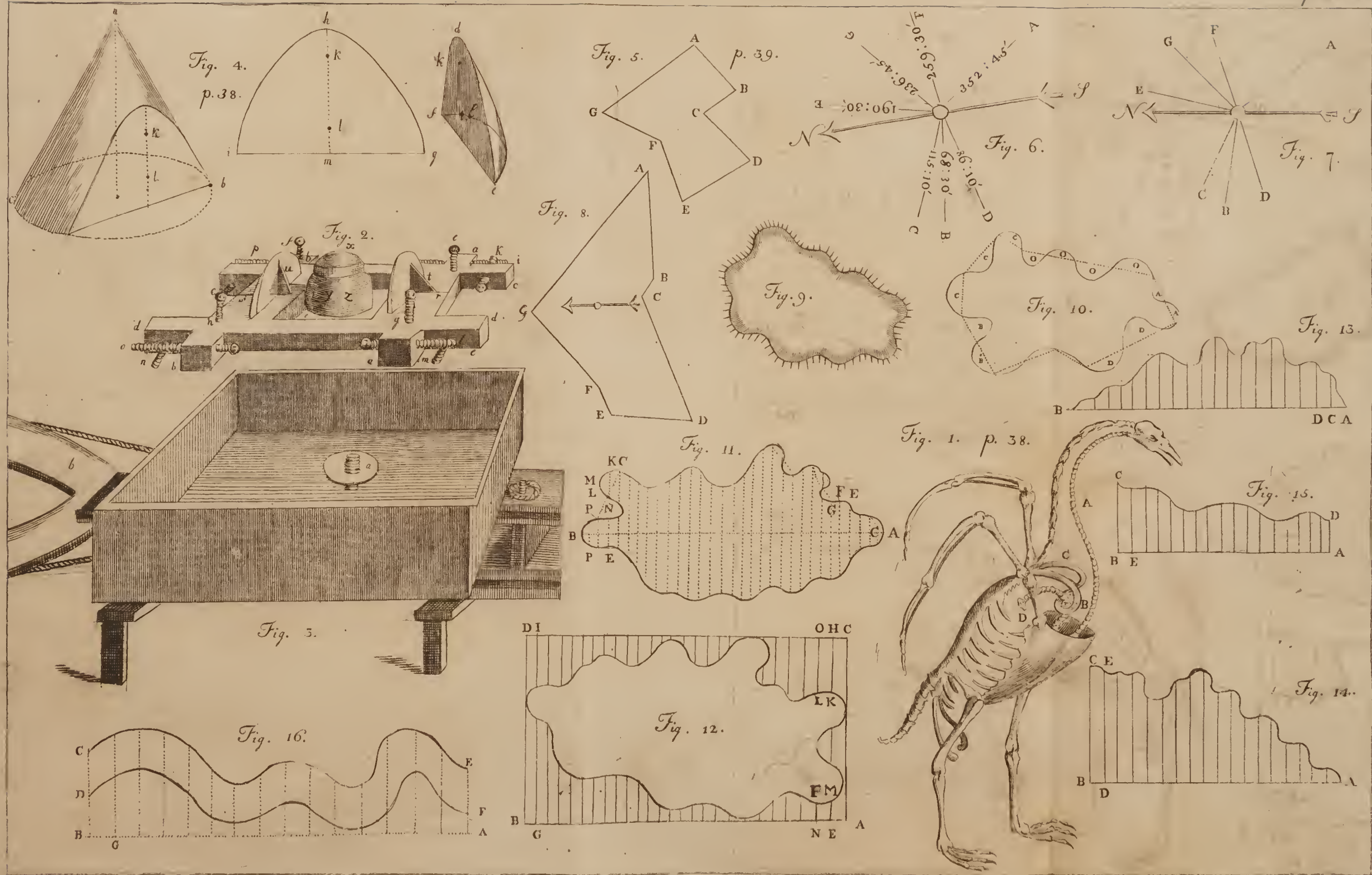
EXPLICATION of the FIGURE.

a The Swan's wind-pipe. b The reception of it within the cavity of the *sternum*. c The triangular *sternum*. d The part of the wind-pipe that enters the lungs.

*An easy method of grinding and polishing Parabolic, hyperbolic and elliptic Lens's. By C. G. Hertelius. From the Miscellanea Bero-
linensia; Continuatio secunda, pars secunda, p. 146.*

Translated from the LATIN.

J OIN square-wise, so as to project their ends beyond each other, four pieces of timber, aa, bb, cc, dd, (Fig. 2. Plate II.) that shall exactly fit the cavity or opening of the lathe (Fig. 3.) Into the ends of the timbers insert, by means of screw-holes, 12 screws; four of which e, f, g, h, to stand upright, and eight, i, k, l, m, n, o, p, q, to be directed in a horizontal position, towards the four sides of the opening of the lathe, either for raising, lowering, moving to any hand, or fastening down the above square frame. Then let a cone be turned of a hard and well-seasoned piece of wood, afterwards to be saw'd out into an elliptic, parabolic or hyperbolic section, according to the figure, designed the glass. Fig. 4. represents the cone, abc, of which, def is a section: On the section apply a steel plate, ghi, equally smoothed on each side, and of a thickness to answer to what was wasted in the sawing; lest upon coming to join the sections, the cone should fall any thing short of its accurate roundness: The plate should every way project, in a manner, beyond the surface of the cone, and the two parts be tied down firm by means of screws or nails passing through the corresponding holes, k l. After which, the projecting edge of the plate is to be carefully filed down, till every where become level with the surface of the cone, it has acquired the perfect section designed, whether parabolic, elliptic, or hyperbolic; and you procure an exquisite model of grinding your Glass by: In like manner cause to make another model, by means of the same cone, in every respect like the former: as also several pairs of models, yet of different sections and sizes, for forming divers Lens's by, and all of them to be marked with a right line, h m, tending from the vertex to the middle of the base: After this too, let the opposite pair of timbers, aa, bb, (Fig. 2.) be marked in the middle with transverse lines, r and s, and upon each of the timbers, let each of the models be placed with its axis perpendicular h m, that both may touch the transverse lines r and s, and be parallel to each other. Let both models be supported by the props t and u, and
made



made firm by means of small screws : then let any Glafs be ground in a spherical dish, that approaches nearest to the section wanted, yet somewhat wider ; or if one dish happen not to be sufficient for one Glafs, a number of them, so as to be gradually narrower the one than the other, to be employed in the grinding : by which the Glafs will come in some sort to be of the destined figure, and be a kind of sketch of it. Let the Glafs x , after grinding be, by means of cement, fastened to the block $y z$, and duely applied to the arbor a , so as not to project on one side or other, nor totter by the gyration of the wheel b . The Glafs being in this manner applied, the machine (Fig. 2.) is to be lodged in the box or cavity of the lathe, and by means of the upright and inclined screws to be so ordered, that the vertical points may coincide in a right line with the centre of the surface of the Lens ; which may be known by the extension of a fine thread or hair ; and by screwing or unscrewing may the matter be adjusted : which being done, fasten firmly down the machine, by equal turns of the inclining screws.

There now only remains to explain the act of reducing Glasses to the most perfect conic section : for which purpose have at hand a pretty strong, level, iron-plate, both ways exceeding the distance between the models ; which being laid in a horizontal position on the models and Glafs, shall touch any one of these parts in one point at least. Let this plate be moved up and down with the left hand along the limbs of the models on each side, after first sprinkling common sand, passed through a middling sieve and wetted ; at the same time turning round the wheel b , with the right hand, till the Glafs be brought to the due figure ; which, I am persuaded, it cannot fail of, as the motion of the plate is directed along the edges of the models. After levigation, which is done by means of a finer sand, or of emery, its politure may be given by means of a level piece of lime-tree wood, whose motion is directed by the models, and from the first done over with some putty, and at last with tripoli. In this manner too may concave Glasses of similar sections be ground, only changing the models and the grinding plate.

Some

Some practices in Geometry rendered more easy; by Philip Naudé, the Elder. From the Miscellanea Berolinensia. Continuatio secunda, Pars secunda, p. 235.

Translated from the LATIN.

Surveying, the principal thing therein.

AMongst the more frequent, and at the same time, most necessary and useful problems of practical Geometry, is that of laying down or plotting an Area taken in the field: and of all the methods of executing this, that undoubtedly has the preference, wherein we apply the mariner's compass, or magnetic needle.

Magnetic Needle, its use in Surveying.

This use of the magnetic needle in these operations, I formerly neglected, nay despised, as supposing the needle easily made to swerve from its natural direction by the approach of the least iron, or nearness of the subterraneous veins of that metal; but was at length undeceived by a frequent and successful practice.

'Tis however possible, on some occasions, that the Magnetic Needle shall be swiftly whirled about, and its magnetic virtue there suddenly vanish, which yet is very rarely the case. But to obviate any such inconvenience, it is proper to be furnished with two or more Magnetic Needles, if whole countries are to be laid down; that if one needle happen to lose its virtue, another may be ready to receive it: nay, it will be of service to have the load-stone itself carried about.

Construction of a compass to be used in Surveying.

The box or compass has its limb internally divided into 360 degrees; on its bottom are drawn 8 radii, denoting the 8 cardinal points, one of which has the flower de luce to signify the north, and at the opposite end S. to denote the south; to the right E., and to the left W., to denote east and west. In the middle of the bottom is erected and made firm a perpendicular needle, on which plays horizontally a Magnetic Needle: externally towards south and north are made fast perpendicularly brass plates, with slits in the middle for directing the sight or visual ray from south to north. Two other similar plates are fastened perpendicularly on the limb of a moveable circle, and diametrically opposite; in such sort that these four plates do occasionally the office of the sights of a graphometer.

Compass how used?

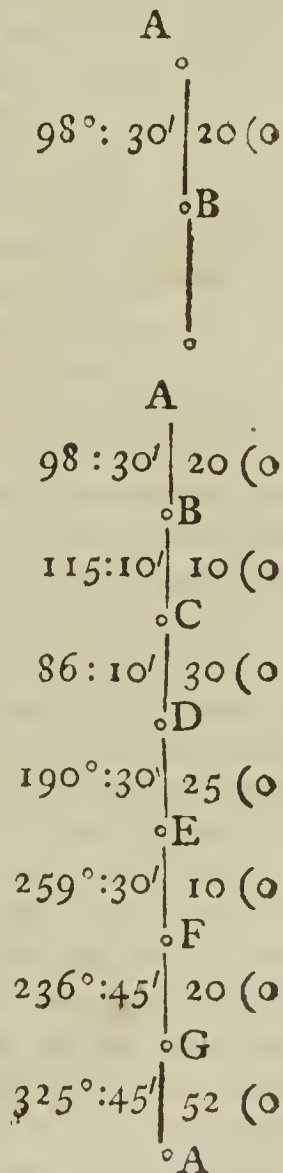
To perform the operations; these plates are to be turned in such a manner, that the one shall look east and the other west. Below, the box has a joint, fastened in such sort, that it may be mounted on a staff before the sight of the operator. And this instrument may be commodiously used, as an astrolabe, graphometer, or mariner's compass.

Let

Let the Area in the field be the figure z (Fig. 5. Pl. II.) to be geometrically laid down on paper. Suppose I begin from the point A through the line A B, proceeding from A towards B: Then I order the assistants to go towards A, there to set up perpendicularly a staff, and carry along with them the chain, whilst I at B mount before me the box with the Magnetic Needle. But 'ere we proceed, we are to lay this down as a fixed rule, viz. always to look in the same manner thro' the sights: That is, that if at the first I lay my eye to the south sight & look to the north, I never omit doing the same for each angle. I therefore prescribe this rule to myself, to look always from south to north, as drawn at the bottom of the box.

At B therefore I begin, and direct thro' the sights the visual ray from the angle B towards the staff A, looking thro' the sights from south to north of the box. Then I order the assistants to quit the staff A, if the figure be such, that it should be closed. Moreover I order them to come to me at B, along the line A B, measuring it in their way: but I at B wait 'till the magnetic needle come to stand quite still: and then I observe what degree of the limb the north point of the needle stands over: And here in B it pointed to $98^{\circ} 30'$; this I set down in my book, near any line at pleasure, A B on the other side setting down the distance A B, measured by the assistants; viz. 20 (0.

Then I quit the staff, erected perpendicularly at B, and convey along with me the instrument to C, where I again look thro' the same sights from C towards the staff B; and there I stop, till the magnetic needle stop too. Its point shews $115^{\circ} 10'$; which I write down near the line B C: The assistants coming from B to C, carry with them the staff, left by me at B, and measure the distance B C; which is 10 (0; which I write down as before. I proceed to shift my instrument from C to D, whilst the assistants fix the staff upright at C: I again look thro' the same sights from D to C, and observe the degrees pointed out by the needle; viz. $86^{\circ} 10'$. The assistants measure C D, bringing with them the staff, which they fix up at D; the distance C D was 30 (0 which I write down by the side of the line C D: and so on, till I come to A again: and from this figure and operation has arisen the prototype here denoted.



In the same manner might the prototype of a figure of fifty angles, of what length soever the sides were, be set down: A commodious practice this, all Surveyers must own.

We may moreover here observe the dispatch of the Operation: The assistants are always measuring, almost as fast as they can run; all the stay being, till the needle come to stand still, and point out the degrees to be writ down.

What has been hitherto advanced is notorious, and there are several Surveyers who often employ this instrument. But to these things I now add a new method of forming the geometrical figure from the prototype; which prototype has no manner of resemblance with the figure itself. The method usually employ'd for constructing this figure is so prolix and intricate, as to have near disgusted me from so expeditious an use of this instrument, had I not hit on a method of laying down with ease the figure on paper, as follows:

Fig. 6.

First draw on paper with a lead-pencil a line, on which describe the figure S N, the magnetic needle, with its point and swallow's tail, to denote north and south: This needle will immediately determine the north and south of the figure sought.

After this, if you want the situation of the first line AB, (*fig. 12.*) set down in the prototype, with the degrees $98^{\circ} 30'$. employ for greater facility sake an entire horn-circle, divided into 360 deg. on which one diameter is drawn with a steel point; the 360 degrees beginning to be reckoned from one extremity of this diameter, quite to 360: apply therefore your horn circle on the line representing the magnetic needle, in such sort, that the diameter of this horn circle shall coincide with this representation of the needle, and the centre of the circle, with the middle point O of the needle; and finally, that the beginning of the numbers on the horn circle be towards the swallow's tail, that is, the south point of the needle.

The middle point O of the needle will denote the origin of all the directions of the lines to be set down; or better, the beginning of each one of the lines drawn in the prototype. That is O will represent the point A of the line AB; the point B, of the line BC; the point C of the line CE, and so on.

Laying the horn circle as was before said, begin to reckon from the swallow's tail, that is, from the south, and proceed to the east quite to $98^{\circ} 30'$: as set down in the prototype near the line AB, and there make the point B, and with a lead pencil draw the line OB, which will give the direction sought of the line AB: Then wherever the line AB shall be drawn on this paper, it should be parallel to this line OB, and its beginning, *viz.* the point A, be towards O, and its point B proceed towards the east of the needle, delineated on the paper.

Now do as much for each line set down in the prototype, as you have already done for the line AB: For instance, I observe near the line BC

$115^{\circ} 10'$

115° 10'. I therefore place the horn circle, as before, upon the needle SN, and I begin in S to reckon eastward 115° 10', and there I make the point C, and draw OC, denoting the direction of the line BC; and so on to the end. Whence arises the above figure, which I call the *Preparatory Rotula*.

I would now hint, that this *rotula* might be formed by one only application of the horn circle: For, the circle being duely and accurately applied, and on it a piece of lead placed, for it to remain immoveable, all the points, designed in the prototype, may be marked round with the last letters of each line, as here the letters, D, B, C, E, G, F, A. Then removing the circle, we may draw all the true lines of direction, as here the lines, OB, OC, OD, OF, OG, OA; which is therefore very accurately and readily done. In this *rotula* we immediately see that the line OB represents the line AB of the prototype; but the line OA, the line GA, on the score of the different origin of these lines.

It may possibly be objected, that this would prove very difficult, were the number of the angles of the figure great; because in that case the points would come to be too near each other, nay sometimes perhaps coincide: In which case there would be no room for inscribing the letters to denote the extremity of each line by. My answer is, that room may always be found, tho' several lines should fall upon each other, or coincide, provided instead of the capital, the smaller letters be used: Because the points denoting each line, may be put unequally distant from the center O; and in this manner nothing shall hinder, but that all the lines may be drawn, or at least distinctly denoted by their proper letters.

If the preparation above described could be readily and accurately done, the geometrical figure would be formed with still greater dispatch, provided a fit place were rightly taken for the first angle A; to find which we shall shew hereafter.

Now supposing this fit place to be in A, Fig. 7, 8, thro' A, I draw with a lead pencil a line, parallel to the radius OB of the *rotula*, and I take in a given scale between the legs of the compasses the opening 20 (0, because in the prototype at AB, the length is thus marked: This done, I compleat the line AB with ink. Again, thro' the point B, I draw with a lead pencil, a line parallel to the radius OC of the *rotula*, making it 10 (0 in length, as marked down for BC; this done, I draw BC in ink. Again, thro' the point C with the lead pencil I draw a line parallel to the radius OD of the *rotula*, making it 30 (0 in length, as is CD in the prototype: And thus proceeding, I accurately and very readily compleat the figure; especially if we employ a rectangle-triangle of wood or ivory for drawing the parallels: And then the business is perform'd almost with equal dispatch, as if each angular point of the figure were given in position. Such then is my method of forming the geometrical figure from

Fig. 7 and 8.

the given prototype. We are now to find the proper place on the paper, for the beginning A of the figure.

The site of the figure to be constructed on the proposed paper, depends on two things; *viz.* on the situation we there give the needle SN of the preparatory *rotula*, and on the position A, the beginning of the figure. To proceed therefore surely, it is expedient immediately to compleat this preparatory *rotula* on some small piece of paper: and being done, lay it on a level table, fastening it there with a soft wax or otherwise: Then take in the scale, designed the figure, with a compasses, the distance AB, *viz.* 20 (0 set down in the prototype; and place the one leg of the compasses in the point you at random design for the beginning A; the other leg apply in such manner on the table, that its position may with the first point of the compasses make a line parallel, at least to the eye, to the radius OB of the *rotula*; and with chalk mark the two points, setting also down the letters A and B.

Then again take in the proposed scale the opening BC, *viz.* 10 (0, and setting one point of the compasses in B, already marked, set the other on the table in such sort, that its position may form with the point B, a line parallel by sight to the radius of the *rotula* OC; and with chalk mark the point and letter C.

Further take in the proposed scale the aperture CD, *viz.* 30 (0; and setting one point of the compasses in C, set the other on the table in such sort, that its position may with the point C, form a line parallel to the eye, to the radius of the *rotula* OD, and with chalk mark the point and letter D. In the same manner mark all the other points E, F, G, and by this means you shall have the geometrical figure depicted nearly on the table, in such manner that the distinction and situation of its greatest length and breadth may be seen.

Then apply the paper destined for the geometrical figure upon this table, by shifting it this way and that, till it exactly cover the figure marked with chalk; and thence take the site of the needle SN of the *rotula*, and the place A, destined for the beginning of the figure to be constructed on the paper; which being done, every thing will be plain.

But if you set down the lines, marked out by the compasses, not only to the eye, but geometrically parallel to the radius of the *rotula*, then all the figure on the table will be geometrically drawn.

Finally, if the first application of the preparatory *rotula*, on the table, to the radius of the *rotula* should cause the figure to project without the table, the remedy is easy; either by shifting the place A of the beginning of the figure, or diverting a little, if needful, the preparatory *rotula* from its first situation, assigned on the table. For, if by the scale the figure may be set off on the table, its not answering so well, and its projecting beyond the table, will be owing to one or other of these defects; either, to the undue site at first given to the needle of the *rotula* SN (for it might

might happen that the scale might bear the figure being constructed on the table, as also the position of the beginning A, and yet not, the undue site given the needle SN) or to the undue position of the beginning A, tho' the scale or given site of the *rotula* might bear it.

I here add another prototype, which shall close another figure, if any one should have a mind to try it.

But if we would know the number of degrees of any angle, set down in the prototype; 'tis now well known to be done by two substractions: The degrees set down both above and below the sought angle are to be taken, and the lesser to be subtracted from the greater number; if the remainder be less than 180, then it is to be subtracted from 180; but if exceeding 180, then 180 to be subtracted from the first remainder, and the second remainder will give the number of degrees of the angle sought: For instance: If we want the number of degrees of the angle C, set down in this last prototype; I subtract 7° from $112^{\circ} 15'$; the remainder is $105^{\circ} 15'$, which is less than 180; I therefore subtract $105^{\circ} 15'$ from 180; the remainder is $74^{\circ} 45'$, the number of degrees of the sought angle C. But if I want the number of degrees of the angle D, I then subtract 7° from $309^{\circ} 15'$, the remainder is $302^{\circ} 15'$, which exceeds 180; from this remainder therefore I subtract 180, the residue is $122^{\circ} 15'$, the number of degrees of the angle sought D.

	A	
$207^{\circ}:50'$		$227(1$
	°B	
$112^{\circ}:15'$		$607(1$
	°C	
7°		$311(1$
	°D	
$309^{\circ}:15'$		$289(1$
	°E	
226°		$167(1$
	°F	
309°		$159(1$
	°A	

It may often happen that an area irregularly curvilinear shall offer to be measured and geometrically constructed; such as are the two represented Fig. 9.10. and the area shall both from without and within be every where accessible, or only inaccessible from within; yet we must always work by Approximation, and that in a twofold manner: Either we consider the figure as a rectilinear of many angles, and its circumference consisting of several very short rectilinear sides, which thus almost quite destroy the curvity, as may be seen (Fig. 9.) Its area is afterwards to be divided like a rectilinear figure into a number of triangles, whose sum exhibit that of the figure. Or we give it a new rectilinear circumference, as (Fig. 10.) so formed, that what the true figure loses in one part, may be compensated in another nearly, as is done (Fig. 10.) where the two spaces *a* compensate each other, as also the two spaces *b*, the two *d*, and the two spaces *c*. Then the area is found too by means of triangles, whose sum is put equal to the curvilinear area given.

But this last approximation is extreme rude, and cannot serve geometrically to construct the figure, or tolerably represent it. But if the figure be anyhow to be laid down on paper, the first method hinted for Fig. 9. is the more preferable: In which case the above mentioned use of the magnetic needle is highly conducive, and better than all the common ways.

But

But when such a figure of many small sides, already constructed on paper, is to be calculated or cast up; it is to be divided into several rectangles and triangles, which will cause no small trouble: I therefore bethought me of another way of laying down on paper such an irregular curvilinear figure, and then casting it up, and that by one only multiplication; a way approaching the accurate truth as near as any other, and is as follows.

Fig. 11.

Thro' the greatest dimension of the figure draw the line AB , Fig. 11. which divide into any number of equal parts, and the more numerous the parts, the nearer you approach the true area; thro' all the points of division of the line AB draw perpendiculars, reaching to each side of the figure: Measure all the perpendiculars and one of the equal parts AC : Add all the perpendiculars together, and multiply their sum by AC , one of the equal parts of the line AB ; and the product will give the area of the figure nearly: There is here no other error besides that arising from the figure not being included in small right lines, to be drawn thro' all the extremities of the perpendiculars; a very inconsiderable error, that: For were these small lines drawn, there would thence often arise a necessary compensation, pretty exact, as may be seen by the line GH . But if any perpendicular happen to cut the curve three or four times, as IK , not all IK is to be set down in the addition, but only IL ; supposing L to be in the middle of MN ; for in this manner there will be had a pretty accurate compensation, as may be seen by the line CLP .

By the same method may be form'd geometrically on paper any such given figure, without any other instrument than that we want for drawing right lines and perpendiculars in the field: For if you set down in your book, the lengths of all these lines, you will compleat the figure, by drawing a curve thro' the extremities of all the perpendiculars.

Here possibly it may be objected, that we require the figure to be every way accessible within side, but that is not needful; this method may be used, tho' the figure were a lake, or any other place quite inaccessible, provided it were accessible without side.

Fig. 12.

In this case the proposed figure is only to be included in a rectangle, whose four sides touch the figure, as is to be seen by Fig. 12. AB and CD will be the greater dimension of this figure, which I may divide into any number of equal parts; drawing perpendiculars to the divisions, and measuring them, I set down their lengths in my book; and thus I may easily construct the figure at home, and cast up as above. To find the sum of the perpendiculars contained within the figure, you need only multiply the length AC or BD by the number of perpendiculars betwixt these two: beginning here from EH , and ending at GI . Then add all the perpendiculars betwixt the limb of the given figure, and the lines AB , CD ; as here the lines HK , OL , ME , FN , &c. Let this sum be subtracted from the above product, the remainder will be the sum of the perpendiculars, which multiplied by AE , or EN , the product will give the area sought.

By

By the same method too, may the area's of any mixt irregular figures be obtain'd by only one multiplication: For instance, suppose a figure bounded by a right line, and an irregular curve, as here Fig. 13. The right line AB is to be divided into a number of equal parts, the more the better: Then from the points of division are perpendiculars to be erected; which added together, and that sum multiplied by one of the equal parts AC. we have the area.

Fig. 13.

If any other figure were included betwixt two right lines perpendicular to each other, and an irregular curve, as Fig. 14. the longer right line AB is to be divided into equal parts; and thro' the points of division, parallels drawn to BC: But in summing up the perpendiculars, only half BC is to be set down; then that sum multiplied by one of the equal parts, as DB, gives the area.

Fig. 14.

If any other mixt irregular figure be included within two parallel right lines, perpendicular to a third, and an irregular curve, as Fig. 15. This third AB is to be divided into equal parts, and perpendiculars erected to the points of division; and in summing, half only of the two extremes, AD, BC to be added: And multiplying this sum by one of the equal parts, as BE, you have the area sought.

Fig. 15.

Finally, if any irregular mixt figure be included betwixt two right parallel lines, and two irregular curves, as Fig. 16. Then to these two parallels draw the perpendicular AB, which divide into equal parts; and at the points of division erect perpendiculars to AB, or parallels to CD, EF: Sum up all these parallels, and only half of the two extreme parallels CD, EF. Then multiply this sum into one of the equal parts, as BG, and you have the area of figure 16. Thus far of regular figures.

Fig. 16.

There are also some compendiums for regular figures. For instance, all regular polygons of the same denomination, that is, having a like number of angles, are mutually similar: All circles, all sectors of a circle, whose subtended angles are mutually equal, are also mutually similar figures. This being well observed, and if besides, we duly understand the usefulness of decimal arithmetic, which in geometry is extraordinary, we shall thence procure very elegant compendiums.

For in this case, if we once take the trouble to cast up the area of a figure in each kind, whose side, or diameter, or radius is 1 (0, there will thence arise an excellent compendium.

But in the first place I call that Decimal Arithmetic, in which the integer or first linear measure, as a rod, perch, fathom, &c. is divided into ten equal parts, called *primes*; a *prime* again divided into ten equal parts, called *seconds*; a *second* divided into ten equal parts, called *thirds*, and so on.

Decimal Arithmetic. what?

In planes the integer square measure is divided into 100 *square primes*; a *square prime* into 100 *square seconds*; a *square second* into 100 *square thirds*, &c.

In

In cubes, the integer cubic measure is divided into 1000 *cubic primes*; a *cubic prime* into 1000 *cubic seconds*, &c.

Moreover, in this Algorithm, after the integral parts, is set down, separated by a crotchet, the value of the last numeral character; and the dimension, in its proper character, as *q* for plane, *c* for cube, excepting the linear, which need not be expressed.

If in lines I would write down 43 integers, I set them down thus; 43(0: But if I would write down four integers, and three primes, I do it thus; 43(1. If I would set down four primes, and nine thirds, I do it so; 409(3. And so on.

In planes; if I would write down 54 square integers, I write 54(0q. If I would express five integers and nine square primes, I do it so, 509(2q. If I would write down 40 square primes, 76 square seconds, I write 4076(4q. To express nine square primes, and eight square seconds, I do it thus; 908(4q, &c.

In cubes: 76(0c denotes 76 cubic integers: 9573(3c signifies nine cubic integers, and 573 cubic primes; 7009(3c stand for seven cubic integers, and nine cubic primes: 8076(6c expresses eight cubic primes, and 76 cubic seconds.

Hence may be seen that in lines, to each denomination is allotted one single place; as to primes one, to seconds one, to thirds one, &c. Because beyond nine, the denomination changes to a higher.

In planes, to each denomination are reserved two places; as two to primes, two to seconds, &c. because as far as 99 the same denomination subsists.

In cubes, to each denomination are three places allotted; three to primes, three to seconds, &c. because as high up as 999 the same denomination is continued.

Hence it is, that for the greater clearness, it matters not in lines, what number is put after the crotchet, which is the fractional index or character. But in planes, it should be an even number, and in cubes, a ternary: And where it is not so set down, it is so understood to be, by virtue of the position of the last figure: For 46(1q and 460(2q are equal; as are 49(1c and 4900(3c. On which account it is proper to complete the fractional index, which is an even number in planes, and a ternary in cubes, by a due apposition or removal of cyphers; so that instead of 42(1q, we write 420(2q; or in lieu of 49540(4c, 4954(3c, and yet their value remain unaltered.

The method of operation remains the same, as if all the parts were integers; only observing that in addition and subtraction, the fractional index and the dimension of the numbers remain the same, that they were in the given numbers.

But in multiplication, both the fractional character and dimension are changed by addition : for here the sum of the fractional characters will give the character or index of the product, and the sum of the producing dimensions, the dimension of the product: as if 4(1 be multiplied by 4(1, the product will be 16(2: and 16(2q multiplied by 4(1 gives 64(3c, &c.

In division the fractional index and dimension are changed by subtraction, because division is contrary to multiplication. The fractional character therefore of the divisor is to be subtracted from that of the dividend, and the remainder is the fractional index of the quotient. Moreover, the dimension of the divisor is to be subtracted from the dimension of the dividend, and the remainder is the dimension of the quotient: As if I divide 64(3c by 16(2q, the quotient will be 4(1; but if I divide 64(3c by 16(1, the quotient will be 4(2q, which stands for 4 square primes. For a line has one dimension; a plane, two; a body, three.

These things being well observed and understood; for calculating the areas of regular polygons, use only the following table, in which I exhibit the areas of 10 such, the length of each of whose sides I suppose 1(0.

A R E A					A R E A				
Of a Triangle	-	-	-	43(2q	Of an Octagon	-	-	-	481(1q
Square	-	-	-	1(0q	Enneagon	-	-	-	617(2q
Pentagon	-	-	-	172(2q	Decagon	-	-	-	765(2q
Hexagon	-	-	-	260(2q	Endecagon	-	-	-	935(2q
Heptagon	-	-	-	361(2q	Dodecagon	-	-	-	1116(2q

For instance, let it be required to find the Area of any regular decagon, whose side is 32(1, I only square 32(1, which makes 1024(2q, and multiplying it by 765(2q, the product is 783360(4q, for the area of the decagon sought, yet retaining the plane or square dimension; because after this multiplication, there is understood a division made by 1(0q, which in the product changes nothing but the dimension: for it is well known, that similar polygons, are to each other as the squares of their homologous sides, In the same manner may all regular polygons be calculated by help of the preceeding table.

The surface of a circle being sought, either its diameter, circumference, or both, are to be given; if any one of the two, the other is sought by means of the ratio of the diameter to the circumference, which is commonly put as 7 to 22; but for the sake of a more expeditious calculus, and because also we employ decimal arithmetic, let the ratio be put as 100 to 314, which is much nearer the truth than the former.

Now it is evident, that the peripheries of circles are as their diameters.

LITERARY MEMOIRS

Let the first compendium then, supposing the diameter given, and the periphery sought, be as follows; namely, multiply this diameter only by 314(2, the product will give the circumference sought: always keeping the linear dimension, on the score of a division here understood, and hinted at once for all.

The second compendium, supposing the periphery given, and the diameter sought, will be to multiply this periphery by 318(3, the product giving the diameter.

The third compendium, supposing given the diameter, and sought the area of the circle, will be to multiply the square of the diameter by 785(3, and the product is the area sought.

For the fourth compendium; given the circumference and sought the area: multiply the square of the circumference by 794(4 and the product will give the area sought.

Fifth compendium for the sector of a circle, whose radius and the number of degrees of the angle are given, and its area sought: multiply the square of the radius by the number of the given degrees, which product is always to be multiplied by 872(5, and this last will give the area sought.

Sixth compendium, if the given angle of the sector contain degrees and minutes: The degrees are first to be converted into minutes; then the square of the radius to be multiplied by the number of the minutes of the angle, and this product by 14533(8, which will give the area sought.

Seventh: If in the ellipsis the two axes be given, and the surface be sought: I say, the product of the axes is to be multiplied by 785(3, which gives the area sought. This rectangle, or product of the two axes we use in the ellipsis, as we did the square of the diameter for the circle.

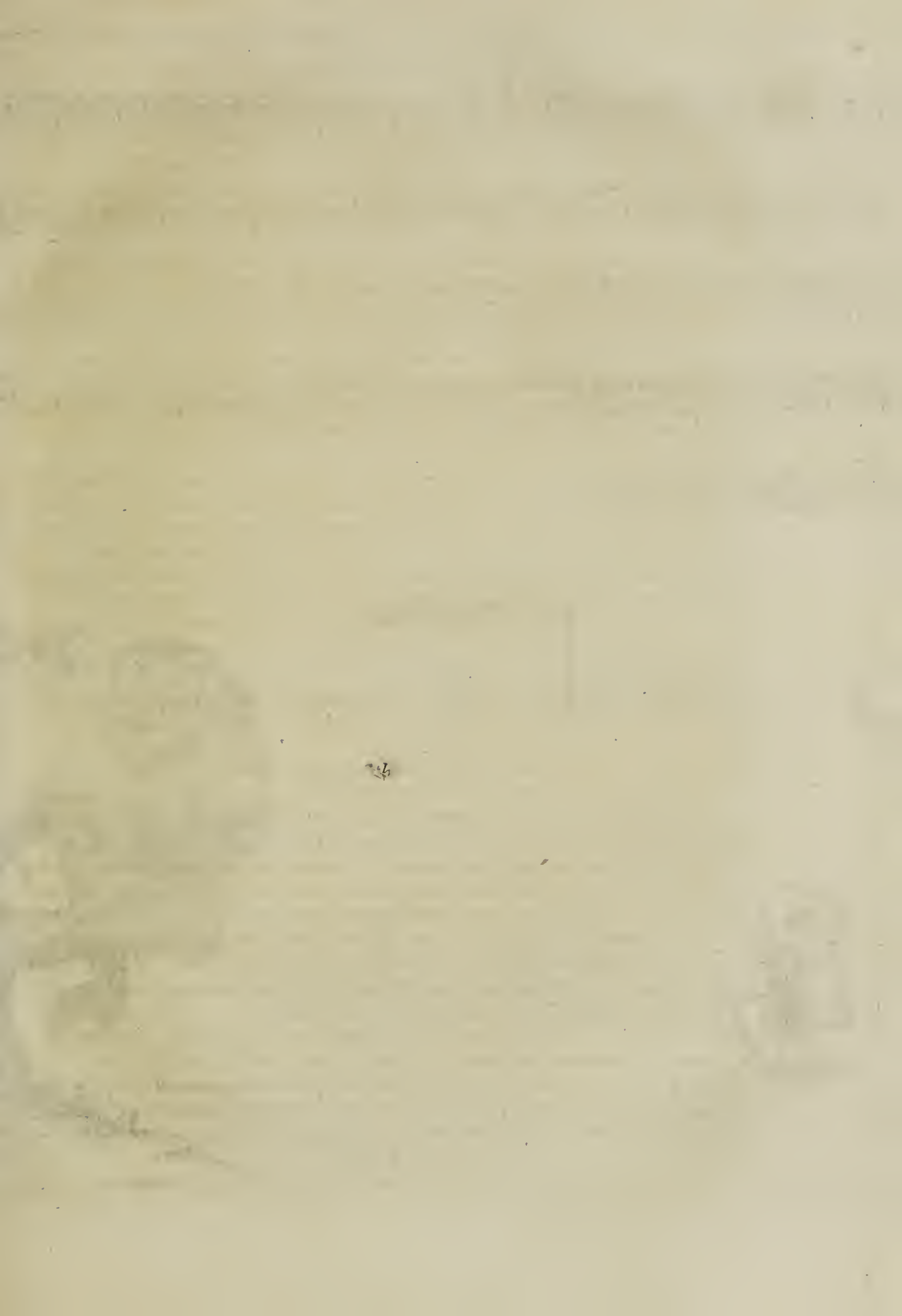
Eight: If the diameter of the sphere be given, and sought its surface: I say, the square of the diameter is to be multiplied by 314(2, and this gives the surface sought.

For the ninth and last compendium: If the periphery of a great circle of the sphere be given, and its surface sought; the square of the periphery, multiplied by 318(3, will give the surface.

If you want the solidity of any regular polyhedron, use the following table, exhibiting their solidities, the side of each of which is 10: The hexahedron or cube I except, as admitting of no compendium.

The S O L I D I T Y of the									
Tetrahedron	-	-	-	-	-	-	-	-	1178(4c
Octohedron	-	-	-	-	-	-	-	-	471357(6c
Dodecahedron	-	-	-	-	-	-	-	-	768496(5c
Icosahedron	-	-	-	-	-	-	-	-	20898(4c

Now,



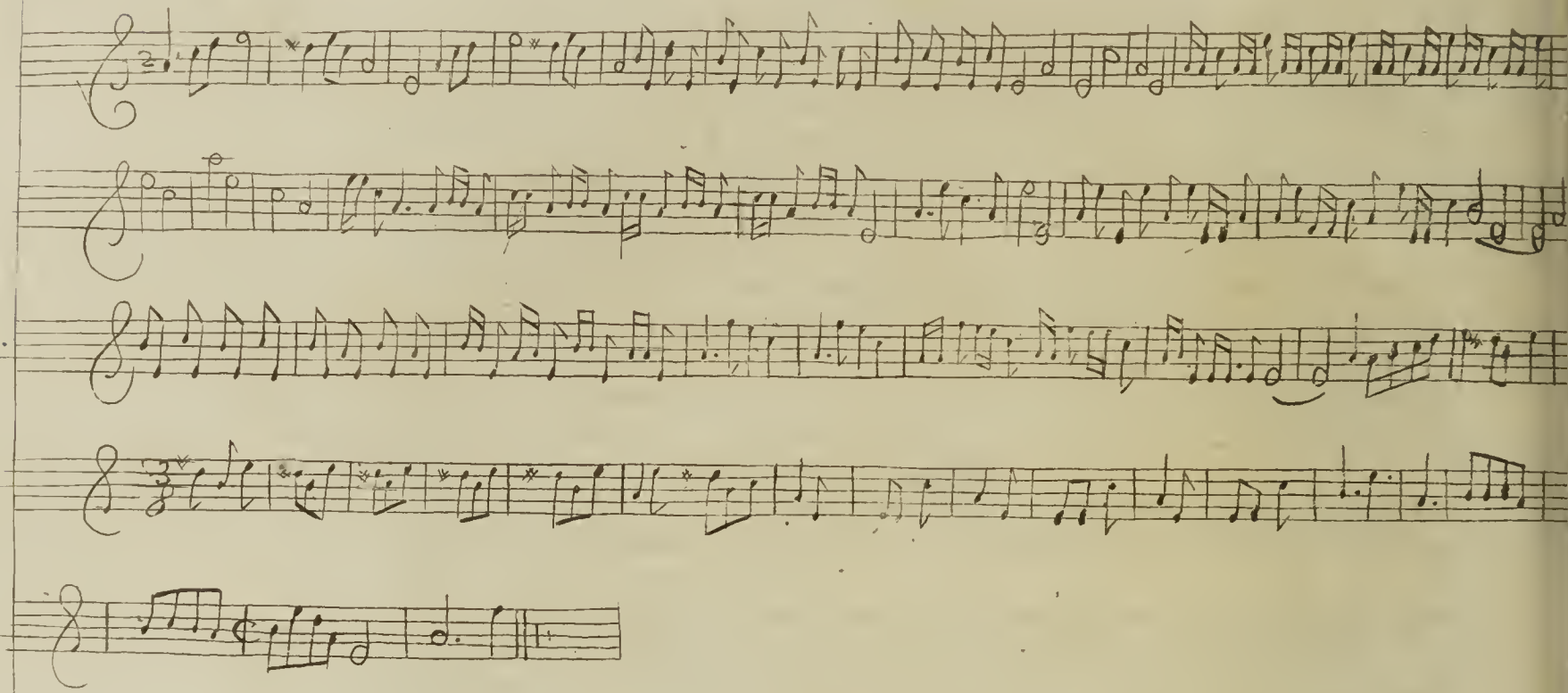


Fig. 2. p. 54.

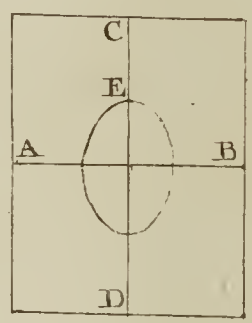


Fig. 3. p. 58.

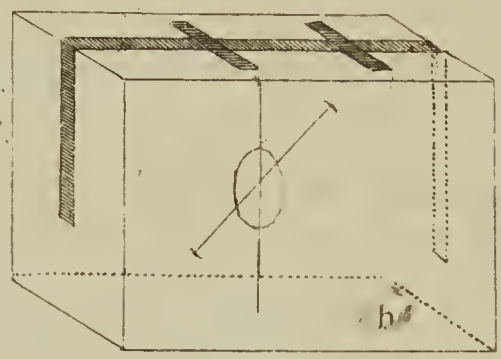


Fig. 4. p. 62.



Fig. 5. p. 63.



The
Size
of

the
Stone.

Fig. 6 p. 72.

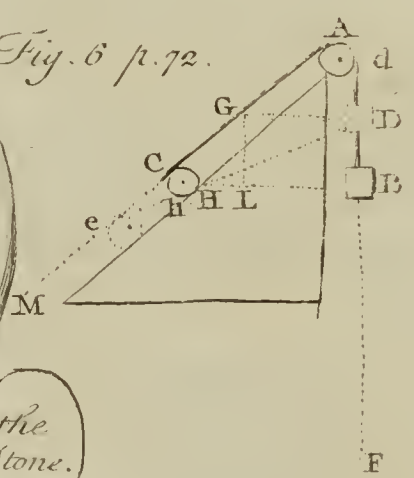
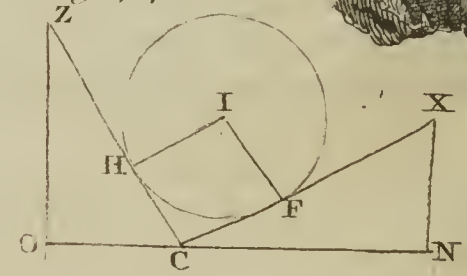


Fig. 7. p. 73.



Now, suppose given the side of any regular polyhedron; for instance, the tetrahedron, its solidity is to be found. The given side is to be cubed, and this cube to be again multiplied by the solidity above given of the polyhedron of the same denomination, as here by 1178(4c; and this last product will give the solidity sought: For, similar bodies are as the cubes of their homologous sides.

(2.) For the sphere: If the diameter of any sphere be given and you would find its solidity; cube the given diameter, and that cube multiply by 523562(6c, this last product is the solidity sought.

(3.) If the circumference of a great circle of the sphere be given, and you would find the solidity of the sphere: The circumference is to be cubed, and that cube to be always multiplied by 168858(7, which product gives the solidity sought.

We now come to the spheroid; which is a solid, generated by the revolution of the ellipsis about its axis; if about the greater, the body is oblong, almost like an egg; but if about the less, it is depressed or flatted, like a pocket-watch nearly. In the spheroid may always be drawn thro' the centre three axes mutually perpendicular. If the two least are equal it is an oblong spheroid; but if the two greatest, an oblate one; and were all the three equal, the body would be the sphere itself: But be they in any of the above proportions, the product of the three axes multiplied by 523562(6 gives the solidity of the proposed spheroid.

Of the Nostalgia, or Home-Ach. From the Breslaw Collection, 1718. p. 832.

Translated from the HIGH-DUTCH.

THE *Nostalgia* or *Home-ach*, as it may be called, is a kind of Ailment, which has been hitherto but little regarded by our Physicians, few of them, except *Harderus*, in his *Dissert. de Nostalgia*, and *Theodorus Zwingerus*, in his *Disp. de Pathopadridalgia*, taking any notice of it. This however is not so much to be wondered at, since the disease from its natural appearance is so very obvious, and very seldom requires the assistance of a Physician, nor submits to his judgment or prescriptions: So that an annotation and description of it might perhaps be ranged in the class of rarities rather than considered as a thing very necessary or usual. This malady either affects the brain or the belly, but generally the former, and discovers itself chiefly in youthful persons, who have been accustomed to their native country, and the mother's kitchen; such a one reflecting on the loss of a parent's table, the conversation of all his old friends and acquaintance, and the manners of his countrymen; from this, and his contemplation on

the grief of his family about his absence, and whatever else may concur to his continual disquietude and perplexity, he feels the activity of his body and mind abated; he delights in nothing; his former good appetite is succeeded by an aversion to food, and what he takes, being poorly digested, is of little or no nutriment, but his flesh begins to fall and decay, his face turns wan and pale, his limbs feeble, the whole body looses its vigour and activity, and sometimes he suffers such a failure of all the functions of the bowels, from discontent, strange air and food, that it is attended with many troublesome consequences, as anxiety, palpitation of the heart, and other heavy symptoms; especially, as it frequently happens, that the diet and the air differ very considerably from what he has been accustomed to, and he finds his whole situation contrary to what a mother's indulgence had long allowed him. In this case the medicinal help is generally very insignificant, and the cure, while abroad, is not accomplished but by a long insurance to the alteration; but the best remedy is a return into his native country, which commonly is effectual to dispel the malady instantly without the help of physick.

This sickness is more prevalent among the *Swiss* than any other nation, on which account it is called there, *La maladie du pais*, and some will assert, that it is hereditary and peculiar to the natives of the canton of *Bern*, tho' at the same time, it is not denied, but that the rest of the *Swiss* subjects are not wholly exempted from it. *Hoferus* (a), relates some particular cases which the *Swiss* officers have observed among their troops in *France* and *Flanders*, and particularly informs us, that new recruits, who, upon hearing the old *Swiss* soldiers either sing or play a certain tune, frequently sung by the peasants that inhabit the *Alps* of *Switzerland*, and called the *cow-dance*, are instantly taken with that malady, and at the same time with a burning fever, insomuch, that the officers were obliged to prohibit the whistling or playing that tune upon any instrument, under a severe penalty. Some of our Readers, perhaps will be pleased to see the notes of that bewitching tune, wherefore we shall set them down here, as they are inserted in that dissertation. See Plate III.

Plate III. Fig. 1. Fig. 1.

But however, we must not wholly ascribe this disease among the *Swiss* to the disquietude of the mind, but in a great measure to the change of air and diet, especially as their native air is more pure and rarified than what they meet with in foreign countries, which to them is generally very thick and heavy. The learned physician *S. J. Scheuchzer*, in his natural history of *Switzerland*, has made the following remarks on this malady, when he says: "Whosoever accurately compares the nature of the *Swiss* air with that of other countries, will find some very useful and obvious hints for resolving a multitude of other remarkable events, an example
" of

(a) *Disp. de Pathopatrialgia sub. Præf. Theod. Zwingeri*, §. 12.

“ of which we find in a treatise entitled, *the natural occurrences of Switzer-*
 “ *land* (b), where the author derives the Home-ach, as a strange and dan-
 “ gerous malady, in foreign countries, principally from the nature of the air
 “ in *Switzerland*, and the changing of it. Dr. *Detbarding*, in his differ-
 “ tation on the healthful air of *Rostock*, seems to be an entire stranger
 “ to the air of *Switzerland*, when p. 32. he says, that the Home-ach of
 “ a *Switzer* arises from the unwholesome air inclosed among the moun-
 “ tains he was accustomed to. This reasoning might indeed appear
 “ good to a native of *Rostock* or *Holland*, when out of a close and impure
 “ sea-air he should remove into the *Switzer* mountains, and there take
 “ in, without doubt, the clearest air in *Europe*; on which account the
 “ *Swiss* are looked upon to be unhappy, as their ever serene and clear
 “ air subjects them to most dangerous fevers and ailments, whenever
 “ they come to be oppressed in foreign countries with a gross, heavy,
 “ thick and strong pressing medium, particularly, with a *Netherland* sea-
 “ air.” This learned author, under that head, ascribes the Home-ach
 principally to the change of air and diet; tho’ he does not deny, but
 that the natural inclination or hankering after home, contributes in a great
 measure towards it, especially, when from a mild and tender indulgence,
 they meet with rough and severe discipline, and other ill treatment from
 their officers.

But we shall dwell no longer on this subject, than just to observe, that
 other nations are not exempted from the like indisposition, tho’ it does
 not always or exactly correspond with the Home-ach of the *Swiss*, which
 is generally attended with a fever; of this a learned friend in *Upper Hun-*
gary communicated to us the following relation, as a true specimen of the
 Home-ach, (which disease is called by *Harder Nostalgia* *.) “ I have ex-
 “ periened it the latter end of *February* and the beginning of *March*, in
 “ B— my brother, who, after we had continued for fourteen days at a
 “ place some distance from home, was always sad, giving himself up to
 “ melancholy: This was attended with a palpitation of the heart, his ap-
 “ petite was gone, and he was troubled with such anxiety in his mind, as
 “ prevented his resting the whole night; I bled him, and gave him some
 “ antivertiginous mixtures and the like, but all in vain, till at last we re-
 “ turned home, when his malady entirely left him, and he enjoyed his
 “ former health.

(b) C. I. §. 11. Tom. I. p. 57, &c. * In Dissert. de Nostalgia Th. II. p. 4.

Of Worms in Fish; from the Miscell. Berolin. p. 43. By J. L. Fritsch.

Translated from the LATIN.

I Formerly supposed it a bold assertion of Dr. *Andry's*, in his treatise of Worms in human bodies, where he says, p. 39. edition *Anno* 1700, that 'with regard to animals, there are scarce any, in which worms are not found.' For so many instances and so much experience are required to establish this, as human industry can scarcely attain. However I begun, and made some progress in enquiries on this occasion; and upon examination, I must confess, that I found worms in beasts, birds, reptiles, in canker-worms, in flies, and such like; insects in insects. And as the same author affirms in his 50th chapter, that 'Worms are found in most Fish,' I resolved to examine several river fish, which I imagined to be the more liable to them in our river *Sprae*, as it is muddy and slow, and stagnates in many places, by reason of the sluices and mills. Neither was I mistaken, for I did not only discover different worms infesting the skin and surface of fish, such as leeches, lice, and some of the *Scarabæus* or beetle kind, but I found them also in their guts and head. Among other fish of this river, there is a sort of whiting, which abounds remarkably with worms. The last I dissected was scarce four inches long, yet had three worms, of which one was a foot, another 8 inches, and a third 5 inches long; so that the first was three times the length of the fish. They were not contained in the guts, but were concealed in the head, between the gills, adhering to those red fibres, which many consider as the lungs of fish. This very narrow cavity in so small a head had obliged these worms, whose length together was 25 inches, to knot themselves up. See plate III. fig. 2. The largest had the most, the shortest the fewest knots; every knot rendering the body 3 inches shorter. They were measured after being unknotted. I observed an artery along the back, from their head to their tail, sufficiently conspicuous, by the blood it contained, and distinguished, as often as they extended themselves from the whiteness of their other parts; but which, upon their contraction, became more obscure. The breadth of the body was gradually lessened towards the tail, and terminated in a very acute angle. The head, or fore-part was somewhat obscure, which it could retract in such a manner, as tho' it had been cut off. I found the same sort of worms too in the fish called bleak, which many authors call the Bream or *Ballerus*, and others the *Plafya*.

*The Mildew in Corn accounted for. From the Breslaw Collection,
An. 1718, p. 594.*

Translated from the HIGH-DUTCH.

THIS is the discovery of the celebrated professor *Wolf*, in some measure indeed clashing with what is commonly advanced on this head*. But his happier genius enables him to reduce to a degree of scientific knowledge the most common, but necessary and useful facts in agriculture and gardening.

Wheat has been frequently observed to be mildewed; barley sometimes, oats more rarely, to which we add millet, from our own experience. The remedies hitherto proposed against it, have, he remarks, proved ineffectual, from the not rightly understanding the nature of the mildew; by some ascribed to dews; by others to the seed itself: Entirely rejecting the fatty and oily dews, advanced by *Chomel*, *Becher*, and *Florini*; he proposes his own notion of it, from ocular inspection and observation: namely, that one grain of barley lodged in the box under the window of his chamber, and secured from dew and rain, became mildewed equally with what had been sown in the open fields. The principal ear, as also one of the side-ears proved good, and again produced good sound ears; but another side-ear was mildewed and yielded others mildewed too: The beards of the mildewed ears were neither long, straight nor green, but twisted and whitish; the grain fuller than that of the sound ear, but mostly black, sprinkled up and down with green: Towards the point the grain divided into three parts, so as that on each side other grains seemed to shoot out, or three corns to grow into one: And by the microscope, the mildewed barley corn appeared a monstrous production with three bodies; as did an oat-corn, monstrous, and spotted black.

From which he concluded, (1.) That mildewed corn is nothing other than a monstrous production. (2.) That the motion of the juice in such misshapen figures was impeded. (3.) That the juice comes to stagnate, and consequently, (4.) To corrupt.

The cause of such monstrous productions, our author could not hitherto discover; and to this he ascribes the miscarriages in the cure.

* Vid. *Act. Germ.* Vol. I. p. 132.

On the Usefulness of Ashes in Agriculture. From the Breslaw Collection, An. 1718. p. 1388 & 1409.

Translated from the HIGH-DUTCH.

FOR the improvement of land, and particularly for the increase of corn, many have had recourse to salt, especially nitre; after having observed, that soils, much impregnated therewith, manifest a greater degree of fruitfulness than others; as for instance, the province of *Xantung* in *China*; where the earth is as salt as sea-water, yet producing the finest corn, best grapes, &c. of any part in the world, not only for quality, but in considerable quantity too (a). And the *Chinese Denys Kao* testifies, that any one year's crop is sufficient to support the inhabitants for ten years running (b). In the same manner is the fertility of the *Ukraine* to be accounted for; tho' here more owing to art than nature; in regard that every spring they there burn down the grass, that has been withering all the winter over, and which, when green, could have reached above a horse's belly; and the resulting ashes, as an alcali salt, may greatly serve to improve land.

But in what manner salts, especially the nitrous and alkaline sort, exert their virtues; whether by a material influx upon the mixtion of plants, or by keeping the soil moist? as alcali's especially attract the moisture of the air and earth, thereby supplying abundant nourishment for the increase of vegetables; or whether in any other manner; is still a question?

Potash or soap-boiler's ashes have, after elixation, been found greatly to improve lean, sandy and dry grounds: And upon making an experiment with these ashes and common dung, on two distinct parcels of land, sowed with four bushels of corn each; from the ashes there were reaped $11\frac{1}{2}$ shocks, and from the dung, not quite 7: The standing corn from the former was upwards of 4 foot high; and each shock yielded from 5 to $6\frac{1}{2}$ bushels: The other from the dung was scarce half so high, giving only about 3 bushels the shock.

I take ashes to be the quintessence of all dungs, in regard that they not only make the seed fruitful, and promote its increase and shooting greatly, but serve also to root out all manner of weeds; nay, greatly cleanse pasture-grounds, tho' all over mossy, rendering them in a short time a fruitful clover-bottom: Whereas dung, on the contrary, especially the fresh sort, does, on the score of its crudity, promote the growth of weeds.

Ashes

(a) *Palissy. Tr. Moyens pour devenir riche* p. 221 seq.

(b) *Vid. Isbrand Ydes Voyag.* p. 270.

Ashes mixed amongst good clean wheat, and daily stirred in with it (the wheat thereby turning so hard as scarce to be bit) are observed to prevent its mildewing little or any: The same thing holds of old corn, as that of one or two years old, and for the same reason, namely, its becoming hard: Lime also has the same effect.

A particular account of the manner of preparing the Blue Ashes in Prussia. From the Breslaw Collection, An. 1718. p. 1391.

Translated from the HIGH DUTCH.

TO the preceding account we think it not improper to add the method of preparing the Blue-ashes, a species of Potash, as it was communicated to us by Mr. *George Hellving*, minister at *Angerburg*, as follows.

The Blue-ashes are prepared from the common ashes, procured from the burnt wood of lime, beech, willow, hazel trees, &c. the turpentine kind, as the fir, pine, &c. being unfit for the purpose. The wood is first burnt to ashes in the open air, then the ashes are preserved under a shed, to screen them from the wet: After procuring a sufficient quantity of these ashes, you run or melt them thus: First separating the best ashes from the worst, you throw the former into a furnace, prepared for the purpose, in which they are burnt or calcined, till they come to run or melt: The melting is promoted by a lye made of the worst of the ashes, and with this lye the best are continually watered, then mixed and stirred together, till the matter become of a thick consistence, after which they proceed to the melting them: The lye, to be fit for the purpose, is boiled till it turns thick, and has a skin a finger thick upon it. After the ashes are fully calcined and run together, they shew blueish; and then they are packed up hard in casks of several sizes, and prove a considerable branch of trade, which is carried on at *Konigsberg*, *Elbing*, *Thorn*, and *Dantzick*, and from thence to *Holland* and *England*. The ashes, when burnt from a soft kind of wood, shew of a light blue, but from a hard, of a dark blue. This sort of blue ashes is employed in dying, soap-boiling, &c. and is inferior in goodness to the potash, as this last requires a better sort of wood, and a larger quantity of ashes; yet preferable to the weed-ashes, as these are thrown into a furnace and burnt without any lye. In other respects the Blue ashes are very sharp, affect the tongue, and hold much salt; they must always be kept dry, as on the access of moisture, they turn like a lime or meal, and must be worked over again. The workmen must avoid using roots of trees, or any oak wood, as the former are full of earth, and spoil the ashes, and the latter yield no good ashes. The apparatus for this process are 6 large

and 6 small troughs to each house, these last being for holding the lye; two coppers of $1\frac{1}{2}$ ton built up with masonry; a smelting furnace, and a good secure shed for the ashes.

From Claus Roemerus to G. G. Leibnitz, concerning an Instrument of his own invention, for astronomical Observations. From the Miscel. Berolin. Pars. II. p. 276.

Translated from the LATIN.

OUT of a number of thoughts, I shall at present collect one concerning an instrument, for which I have longed to see a proper chamber or building these twenty-five years, but never met with one compleatly to my wishes.

Pl. III. fig. 3. The instrument is a meridional axis six feet long, revolving round the poles A B, supported by solid walls, and carrying in its middle, the meridional circle E, of 4 or 5 feet diameter, with the tube C D of 6 or 8 feet, which revolving in the axis A B, pursues the whole meridian to its very horizons, within 4 or 5 degrees. The instrument must be fixed in a covered apartment, 6 feet broad, which is the distance of the Walls. Its length, according to the meridian, should be 30, or at least 25 feet, and its height not less than 20. And that the whole meridian may appear on the circumvolution of the tube, the top of the walls should have a continued fissure or chink 4 inches wide, the walls of this nearly bisected apartment being bound together by the intervention of a few iron bars.

The instrument itself being easily contrived, the chief difficulty lies in procuring a building of proper strength and situation for the admission of it, which must be considered as its necessary appendage and accomplishment. It can be no ways necessary to make either the instrument or its receptacle any larger. Besides three clocks of the same size and fabric, there is no occasion of any other instrument; all our care should be confined to the firm structure and constant motion of it.

Its use consists in determining the right ascension and declination of all visible points in the heavens, the former by the clocks, the latter by the circle adhering to the tube and axis. If it were not over tedious, I could annex several useful mechanical observations, in managing the parts of this instrument, having experienced it for eight years, during which time I have made use of such an axis (tho' very imperfectly fixed) with no contemptible success, which, God willing, I may hereafter demonstrate, by publishing my observations.

Copenhagen, Decem. 15, 1700.

A Re-

A Remedy for the Scurvy in Greenland. From the Acta Haff. P. 35.

Translated from the LATIN.

Herman Nicolai, who had been twice at *Greenland*, informs us of their common remedy for the Scurvy, which rages so vehemently among them, as to take away the use of their limbs. He observed such great abundance of scurvy-grass and sorrel to grow in a mountain in *Bear-Island*, as to embarrass foot-passengers, which, it was also remarkable, never grew a-part, but close together; as if it were a natural indication for compounding them medicinally, as each by itself might be prejudicial, one abounding with an acrid volatile salt, the other being sensibly replete with an acid; the result of which combination and mixture is of an intermediate quality and nature. The common method of using them in *Greenland*, is to make a broth of the fresh flesh of birds or rein-deer, with a decoction of oats or barley, and to impregnate this soup with these antiscorbutic herbs, which proves an extraordinary medicinal diet, that keeps the body open, evacuating the corrupt humours as readily as a purging potion, and so thoroughly purifying the juices, that the patient seems to attain a new constitution.

Birch Beer. *From T. Bartholin. Act. Haff. p. 49.*

Translated from the LATIN.

THE juice of birch is serviceable to persons afflicted with the stone, as well as the dropsy, being plentifully furnished with a vegetable salt. Dr. *Payngk*, the king's chief physician, frequently compounded it into a nephritic draught, with a water distilled from wild thyme and mulberries. A beer is made from the juice of this plant of singular flavour and service, which the noble *Peter Resen* president of *Copenhagen* uses as a precaution against the stone. If malt-liquor brewed with oatmeal is substituted in the room of that brewed with barley, it becomes more efficacious, of which the *English* have experienced the advantage in nephritic patients. To which if our common carrot-feed were added, or suffered to infuse in it during fermentation, it would bid fair for a very efficacious beer in such disorders.

A Dripping or Stillation of Urine ; by T. Bartholin. From the Acta Haef. p. 52.

Translated from the LATIN.

A Colonel, who was troubled with a continual dripping of his urine, could not restrain or stop it, without a manual compression of the *perinæum*. Being consulted about this disorder, I imagined there was a resolution of the *sphincter* of the bladder from the acrimony of the urine : To soften which acrimony, and to relieve and restore the *sphincter*, I prescribed an emulsion of almonds, with the cold feeds in barley-water, which effectually repressed this complaint.

Of the Elk, and the reason of its being subject to the Falling-sickness. From the Breslaw Collection, An. 1718. p. 1524.

Translated from the HIGH-DUTCH.

THE Elk, an animal very common in *Prussia*, *Courland*, *Livonia*, *Norway*, and the other northern countries, is as high as a large horse ; his body of the deer-make, but much thicker and longer ; the legs high, the feet broad and cloven ; the horns large, rough and broad, like a wild-goat's ; yet not furnished with so many small horns as the deer ; its flesh fit to eat, and served up at the tables of the greatest persons.

This animal is ever and anon subject to the falling-sickness ; a circumstance that favours its being taken, which would otherwise prove a very difficult matter. Upon dissecting one, there were found in its head some large flies, with its brains almost eaten away. It is an observation sufficiently attested, that in the large woods and wilderness of the north, this poor animal is attacked, towards winter chiefly, by a larger sort of flies, that thro' its ears attempt taking up their winter-quarters in its head : Whence it is no difficult matter to conceive how the humming and buzzing of these insects, with their devouring its brains, must needs subject it to such a distemper. *Hellving*, a divine of *Angerburg* in *Prussia* informs us, he has several times observed a brood of flies discharged from the Elke's nostrils ; and the head internally stuffed with them : The nearer they lie to the nostrils, the more perfect, and the deeper in the head, the more imperfect they were observed ; some of these last being still in their maggot-state : And which is surprising, they also bred in the

the skin of this animal, and particularly about the spine; and being come to perfection eat their way thro' it.

A method of entirely removing and renewing the Bark of Trees.
By J. L. Frisch. *From the Miscell. Berolin. Contin. II. p. 26.*

Translated from the L A T I N.

TH E lord of Carpzow, a generous promoter of all useful studies, communicated to me his method of recovering the bark of fruit-trees, of which he has great numbers, in his fine orchard at Carpzow. If he sees an apple or pear-tree with an unsightly rough coat, a cherry with a resinous stock, or deformed with excrescences, or any other defect in the Bark, that might possibly either impair the future fecundity of the tree, or which visibly lessens the handsome appearance of it, he is not content with the common methods of redressing them: He does not shave away the roughness; he does not remove any particular piece of the outward bark, nor cut away knots and plaister them over, nor wound the grain of the tree; but, what may appear more surprising, he strips off the bark entirely from the lowest boughs to the earth; and indeed does not only remove the hard, external bark, but the thin, interior one; so that the naked wood appears, without the least fibre of its cover adhering to it. When this nobleman first assured me of the innocence, and even efficacy of this method of curing the diseases of trees, I could not dissemble my doubts, as it seemed contrary to common experience: For 'tis well known that such trees die, as have been deprived only of a small part of the bark, if the separation has been circular, and quite round the body of the stock. But as this nobleman afterwards favoured me with the sight of a great number of trees, which had been treated after this manner, and contracted fresh barks, experience has convinced me of what I must think was, before this experiment, unknown to us; or, if it was known, it does not appear that any other ever ventured to practise it. Wherefore with the approbation of the author of this method, and for the benefit of botany, and physics, I shall communicate what I thought remarkable and necessary in this operation.

First, let the season for it be the summer solstice, at which time the juices flow more liquid and copious; not overlooking the situation of the garden or orchard, as they flow more readily in trees that enjoy a southern exposure, than in others.

Secondly, let the whole body of the stock be entirely stripped of its Bark, as any remaining inequality would deform the tree, that is to resume a new, entire and shapely covering.

Thirdly,

Thirdly, let the moisture that exsudes from the stock be spread smoothly and equally, with a quill or feather, wherever it should stagnate; and let it be disposed and derived to such parts, as are not spontaneously covered with it.

Fourthly, lest the violent heat of the sun should dissipate the efflux of the juices, let the stock be shaded; more especially on the southern quarter. This also defends it from being disturbed by any kind of dust the winds might force upon it.

Lastly, let there be a particular care to avoid any external impression on the tender renascent bark, as the least friction must injure it in that state.

This discovery cannot fail of being very useful to those trades, that the bark of any trees are employed in, and must be especially profitable to the proprietors of such trees.

*The Anatomy of a Monkey, called a Mamonet; by T. Bartholin.
From the Act. Haff. p. 67.*

Translated from the LATIN.

Pl. III. fig. 4.

THERE was dissected in the house of Henry Jacob Scriverius the king's chirurgeon, a Monkey from India, of an unusual figure, called a *Mamonet*, which died in *Fort Royal*. He had a hog-like head, was bare-buttocked, and of a colour somewhat like *minium*, or red lead. We meet with no draught among the writers on animals, that resembles this. *Johnston's* Monkey, described in the 59th table had a long tail, but this was without any. *Gesner* tells us of one, p. 862, not very different, excepting that its head rather resembled a Dog's. *Albertus Magnus* calls one species of Apes with tails *Mamonet*. *Gesner* further says, p. 856, that the *Mamonet* is an animal less than an Ape: But ours is larger, and has no tail, so that we may suspect, as this creature is delineated by none, and has a very horrible countenance, it is either a monstrous production, or one not hitherto seen or depicted. But however that may be, we were, many of us, invited by *Scriverius*, to the dissection of this *Mamonet*, where we observed the following appearances, which I do not remember to have seen in other animals.

1. There was not the least trace or resemblance of a navel.
2. The testicles were pretty large, and placed about the middle of the *os pubis* above the *penis*, which was considerably long, and provided towards the middle with two round muscles, which served to erect it. The greater *prostatæ* were properly disposed on each side, to which the smaller orbicular ones were annexed. The *Vesiculæ seminales* were minute glands

glands, and without any contained humour, tho' the animal is extremely falacious, never looking at girls, without evident desire and lasciviousness.

The liver, consisting of three lobes, is furnished with the same number of lymphatic bladders, as large as a fist, strictly joined about the middle of their convexity to the *parenchyma* or membrane of the liver, tho' separable without much difficulty; and being contained within the concavity of the lobes, they are accompanied with lesser *vesicles*, not unlike the manner observed in the *ovaria* of animals. The coat of these bladders was pretty thick, and divisible into farther membranes: They contained a pure lymph, which being exposed to the fire remained thin or simple like water, the glutinous parts of it very probably concreting into membranes. This water was secreted from the liver by some invisible passages.

4. A *vesica* or bladder of the same kind was also found in the lungs.

5. A grumous mass of blood, adhering by certain fibres, was found in the ventricles of the heart, which, obstructing the circulation, kill'd the creature.

6. A great quantity of water was collected between the skin and the muscles of the head, which might be considered as a dropfy, and be induced by the difference of air and diet, and the drinking of beer.

7. His spine was manifestly bowed and tortuous, but whether naturally, or otherwise, I am ignorant.

8. The spleen was very small, being scarcely as long as the breath of three fingers.

9. The *septum cordis* seemed to be very perviously porous, which circumstance may be worth enquiring into in other Animals.

Extract of a Dissertation, first published in High-Dutch, An. 1717; by J. C. Schott. From the Miscell. Barolin. Vol. III. p. 336.

Translated from the LATIN.

THERE is a stone, of very elegant workmanship, in the royal jewel-chamber at *Berlin*, and of no little singularity, with regard to the emblem or device of the sculpture, under which the designer undoubtedly proposed to couch some latent sense, and profound meaning; and in the enucleation of which antiquaries have not sweated and differed a little. Many of them conclude the human face in the jewel to refer to *Socrates*, and the other figures, to his accusers, which they endeavour to evince by such arguments, as, in so obscure a matter, are not without some probability, tho' they afford little demonstration. Neither is their opinion much better supported, who endeavour to interpret it of the rural god *Pan*.

Pl. III. fig. 5

Pan. Other persons suppose it pregnant with a divine or mystical purpose, while some imagine it to refer to an historical event, to romance, prodigy, magic, or finally to be only a meer exercise of the wit and imagination. But to me, I confess, this symbol seems truly to designate the merit of some extraordinary prince, both in war and peace, and his assiduous culture both of the religious and civil rights of his subjects.

The venerable head of an old man is the symbol of sage advice: Age seems qualified to deliberate; youth to execute. Thus *Florus* in his account of *Romulus* says, lib. i. chap. i. ‘The youth, divided into tribes, were always prepared for any sudden action; the care of the common-wealth was committed to people of mature understanding, who were named *Fathers* from their authority, and the *senate* from their age.’ The rays or points, prominent from the bald head, designate an extraordinary measure of supernatural light in the understanding. They resemble those which are circumfixed in old coins, to the face of the sun, after which the *Romans* fashioned the *radiated crown*, they usually adorned the heads of their deified emperors with. It is altogether probable they intended to signify something divine and celestial by these rays, which supposition may be very naturally referred also to this radiated head: To which purpose *Seneca* says, epist. 41. ‘The rays of the sun are continued to the earth indeed, but exist peculiarly in the place from whence they are emitted: Thus a great and exalted soul may be sent to furnish us with a juster relish of divine things. It converses indeed with men, but adheres to its perfect origin.’

The exclusion of youth from the cabinet is not a necessary consequence of this; it only follows, that our counsels should not be precipitate, but more agreeable to the pace of age, conforming to that device of *Augustus*, *Festina lente*, which *Suetonius* informs us, he applied to military conduct, affirming a cautious general to be preferable to a bold and forward one.

War is to be commenced after mature deliberation: War is represented by the head of a fierce horse. Their continual use in war made them a symbol of it, and *Anchises* prognosticates war from the sight of those noble animals, upon his first arrival in *Italy*.

————— *bellum O terra hospita portas,
Bello armantur equi, bellum hæc armenta minantur.*

Virg.

Steeds on these seats our future wars proclaim,
For steeds, employ'd in war, denounce the same.

This creature was also sacred to *Mars*, and those harnessed to his war-chariot were named *Pavor* and *Terror*. *Natq. Com. Myth*, L. ii.

The

The laurel he holds in his mouth, denotes victory, and was always dedicated to triumphs and conquerors. *Apollo* thus addresses his beloved *Daphne* at the instant of her transformation :

*Tu ducibus lætis aderis, cum læta triumphum
Vox canet, & longas visent capitolia pompas.*

Ovid. Met.

Crowning the chiefs whom ecchoing triumphs raise,
Thy leaves shall publish conquest, joy and praise,
While the long pomp the capitol surveys.

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The laurel was also a symbol of immortality.

Peace succeeds the glory of conquest, which is expressed by the *Caduceus* or Wand, engraved on the jewel behind the horse : The serpents wound about the wand are a symbol of the force of prudence and eloquence, by which peace is procured and concord effected between the most violent natures ; whence those who were sent to treat of, and conciliate a peace, were termed *Caduceatores*.

The improvement of agriculture and farming ensues on peace, whence follows a general plenty. This is represented in the stone by the head of a weather, with an ear of corn in his mouth. This creature was sacred to *Mercury* the god of trade, and is the symbol of traffick, from its extensive use, and the variety of commodities produced from it ; and as *Mercury* is also deemed the author of manufacturing it.

Tertullian, talking of the ancient *Pallium* or cloak says, ‘ that *Mercury* is supposed, on his being delighted with the soft wool of a ram, to have flead a sheep, and after forming the wool into yarn, to have wove it into the shape of that ancient garment, which he wound about with the tender bark of *Philyra*.’ This opinion is supported by a stone mentioned by *Leon : Augustin* in the edition of *Gronovius*, L. 2. N. 2. where *Mercury* is represented leaning on a ram, with his rod in his left hand, and a purse behind his head ; as he was especially credited with the care and increase of herds and cattle, in which the riches of the first ages chiefly consisted. *Cælius Rhodiginus* remarks, lib. 16. cap. 19. ‘ Some have called *Mercury*, *Kerdous* or lucrative, as presiding over traffick and gain, for which reason they have added a purse to his other insignia.’

The ear of corn represents plenty, as one of the blessings of Peace, Thus *Tibullus* says, Book 1. Elegy 10.

At nobis pax alma veni, spicamque teneto.

———— Sweet peace draw near,
Approaching gently with thy soft’ring ear.

And in old coins, not the ear only, but the very grain denoted its own abundance. This is observable in a coin of *Augustus* in the royal treasury of *Berlin*, on the reverse of which a woman holds a *Caduceus* or wand in her right hand, and in her left, ears of corn intermixed with poppies, with the inscription *P A X* ; the poppy being also deemed a symbol of great fecundity.

The upper figures of this sculpture are supported by the legs of a cock, which are easily distinguished by the spurs. The ancients ascribed alacrity, vigilance, and prognostication to this bird, and therefore supposed it sacred to *Mercury* the alert, *Minerva* the vigilant, and prophetic *Phæbus*. In the present emblem its vigilance is chiefly referred to, as the hieroglyphic of a cock may defigure an industrious person, 'effecting 'all things thro' great attention and assiduity, as all pious magistrates, 'and persons presiding in religious matters should,' as *Pier. Vallerius* observes *Hieroglyphics*, Book II. Wherefore the cock is also a symbol of that piety, that stimulates a good prince to the care of religion, for the glory of God, and benefit of his subjects. *Pliny* mentions one reason for this in his natural history, Book X. Chap. 21. 'Of all birds, says he, the cock 'alone frequently eyes the firmament.' And he adds, that he is a terror to the lion and even to the basilisk. This presaging bird farther reminds us of that prudence, which disposes a provident prince, as it were by divine admonition, to be ever prepared against future events. That cocks have foretold a victory by their crowing is evinced by two instances. One is antique, which *Tully* records. 'At the same time, while *Trophonius* was 'sacrificing at *Lebadia*, the cocks there crowed without the least intermission ; upon which the *Bæotian Augurs* said, the *Thebans* had obtained a 'victory, because that bird when conquered was silent, but crowed, when 'victorious.' The event proved the verity of this prediction, the *Lacedæmonians* being destroyed by them, under *Epaminondas*, with great slaughter. *Cernitius*, a grave author, furnishes us with another example, in the history of the electors of *Brandenburg*, where talking of *Joachimus* (at that time prince, and afterwards the second elector) he says, 'On the 10th of *August*, '1532, the baggage being sent before with 2000 horse, the Marquis *Joachimus* set out on his march against the *Turks*, when there happened an 'extraordinary and unusual thing at *Berlin* ; for chickens that had not 'been hatched above 2 or 3 Days, cackled and crowed so incessantly, that 'it seemed evidently ominous ; and the omen was thought good, as crowing was supposed to presage victory. And the event was truly prosperous ; for *Joachimus* was not only present at the bloody battle of *Leopoldstadt*, but *Cosson* the *Turkish* general being slain, he destroyed the remains of the fugitive army.' To which we might add *Pliny's* observation, 'That these fowls preserve a rule in their families, and exercise a government wherever they are kept.' In this point, he is no ill resemblance of

of a magnanimous prince, who is capable at, all times and places, to defend and adorn the dignity and excellence his maker has distinguished him with. Thus have we proved the cock to be an acknowledged symbol of industry, vigilance, religion, magnanimity and prescience, virtues that constitute the accomplishment of the greatest princes; which being considered with our explication of the other figures, strengthen our conclusion, that the device of this stone was intended to represent some monarch, accomplished with all the arts of peace and war, and a consummate knowledge of administering the religious and civil duties of his empire; from whence I must conclude, that this ancient jewel was set in a ring of one of the *Cæsars*, or some other extraordinary prince, and worn and used as a signet. The simplicity and singularity of the figures greatly countenance this opinion, as it was the old custom to couch the precepts of wisdom and morality under such. The price and use of this kind of stone makes this farther probable, if we may credit *Pliny*, who says, it was more frequently used for this purpose, as it was engraved with less difficulty than other jewels, which were also very apt to cohere with the wax, which the *Sardian* or *Cornelian* stone was less subject to, as *Pliny* observes.

*Lusibus ingenii similes opponere lusus
Quid vet at ?*

THE first figure is not a human head as the former interpreter imagines, (for it is without a neck) but a theatrical vizor, which mimicks one. A different explication of this device; by J.G. Wachterns. Three points or rays emerge from this vizor, which cannot be supposed so many parts of a radiated crown, since they are fewer than requisite, and are destitute of a common ring or connexion. Let these *Apices* amuse such, as hunt for great matters in every trifle: But the mask or vizor is universally allowed to be the symbol of hypocrisy. Hence *Petronius* calls it a false and dissembled face.

*Mox ubi ridendas implevit pagina partes,
Vera redit facies, dissimulata perit.*

Actors, their parts absolv'd, their vizors leave,
To wear the countenance that nature gave.

And *Pinicelli's* inscription on it was: *Vera latent*; the true one is concealed.

Now dissimulation is the principal artifice of tyrants: For tho' all men behave with such reserve and concealment, that our common nature may seem, in some degree, to use a vizor; yet in the life of a tyrant there is an universal hypocrisy and disguise, in as much as they are more wicked than other men, and judge of the disposition of all by their own.

gives us such a picture of *Tiberius* P. 57 — ‘ He never professed what he desired, but constantly uttered sentiments very different from what he thought, opposing what he coveted, and assenting to what he abhorred. He pretended wrath when he was least displeased, and æquanimity in the depth of indignation. He professed pity, where he determined to punish, and dissimulated a prejudice to such as he designed to pardon. He received those he considered as his worst enemies with the most benevolent aspect, and his friends with a very strange and forbidding one. He used to say, the real intention of a prince should be accessible to no man: That the knowledge of it produced many and great evils, and its concealment more and greater benefits: And if this had been his only ill quality, it would certainly have been sufficient to defeat the caution of those persons, who had any transactions with him; when taking all things contrary to his real sentiments, they must suppose him to desire what he was averse to, and be disgusted with what he chiefly coveted. At one time he was so enraged, if any one acted in consequence of his declared opinion, that many were put to death for no other reason: So that it was dangerous not to penetrate into his very soul, as many experienced, who assented rather to his expressions, than his will; and yet there was still greater peril in being acquainted with it: For these were considered as prying into his intentions, which engaged his suspicion and hatred. Finally, he was commonly the safest (if such a situation could occur) who was neither ignorant of his disposition, nor ever contradicted it: For such a man was neither led into a mistake by believing him, nor did he incur his hatred, by discovering that he was acquainted with his designs.’ With such a disposition, and such arts, *Tiberius* obtained and held a crown, not so truly a man as a visor or mask, as we have demonstrated.

The second figure is the head of a horse with a crown of laurel in his mouth. The horse is acknowledged to be a type of war and warriors: the laurel in his gaping mouth denotes that passion for glory and empire, which stimulates a tyrant in the prosecution of an unjust war: For tyrants do not enter upon hostilities to repel invasion, or enjoy peace, the only justifiable motives of arms, but for the sake of fame and conquest: Nay, even conquest itself is not pursued by them for the sake of glory alone, but as it enriches them also with the spoils and treasures of the nations they subdue or plunder. The *Romans* were of this disposition, as *Mithridates* attests, in his letter to *Arfaces*. ‘ The perpetual and only motives of the *Romans* warring with all kings and nations, were, (says he) their insatiable ambition of wealth and dominion.’ This passion tyrants esteem as the peculiar and prime ornament of regal insolence. *Tiridates*, king of *Armenia*, and *Solyman* the second, emperor of the *Turks* are sufficient instances of this; the first of whom commonly said, that it was the glory of a monarch to hold fast his own property, and
endeavour,

endeavour to possess himself of other people's : And the latter, on the capture of *Rhodes*, *A. D.* 1522, made this answer to his grand master of the horse : ' That it was the prerogative of a monarch, descended from such, to invade and plunder others, not indeed from the stimulations of avarice, but the glorious passion of empire ; and that he considered the opposition of any neighbour as a sufficient reason for destroying him ! '

With regard to the *Caduceus* or Rod, nothing is a more certain indication of tyranny : But lest this should appear surprising, we must reflect, that in the decyphering of emblems, the same thing frequently admits of various, and even opposite significations, of which indeed some may be more common and familiar, and others more abstruse, and abstracted from the conceptions of the vulgar : Such we find the *Caduceus* was esteemed by the poets, being alike the ensign of peace, and of such violence also, as terminated in death itself. Whence it is called the *Caduceus*, from *cado*, as not only determining and putting an end to the contentions of men, but to the parties also ; which mortal efficacy of the *Caduceus* is maintain'd by *Virgil* :

—animas sub tristia tartara mittit.

It drives the anxious souls to dreadful shades.

The very same things are effected by a tyrant's rioting in the blood of his subjects, while he punishes the guiltless, and destroys multitudes, before their time, by the ravage and licentiousness of war : So that if we were to study a proper device for a tyrant, it would be difficult to discover any so compleat and well-adapted as the *Caduceus*, with the aforesaid motto from *Virgil*. The *Virga* or Rod of it, so called, a *vi regendo*, from governing by force, denounces in its very appellation, the violent sway of one over all : While the snakes, with their reciprocal morsures, pourtray that solicitude and internal anxiety, which continually gnaw the tyrant.

——— *diri conscia facti*
Mens habet attonitos, & surdo verbere cædit,
Occultum quatiente animo tortore flagellum.

Juv. Sat. 13.

To conscious minds interior horror springs,
And guilty spirits smart with inborn stings.

This is what the poets seem to have intended under the notion of the furies, whose whips terminate in serpents ; as it is a received opinion, that deeds of wickedness are scourged by stings of conscience. *Socrates* has excellently depicted these interior viper-like gnawings, which *Tacitus* has copied : ' Could the minds of tyrants be dissected, says he, there

‘ would

‘ would be many visible stabs and lacerations : since, as the body is affected with external violence, cruelty, lust and and impious devices rend the soul itself.’

It is further observable, that the cruelty of tyrants is generally blended with riot, and that they have been bloody in some proportion to their intemperance and lust. This vice the ancients represented under the figure of a ram, which is devoted to *Venus*, and signifies a person abandoned to lust. *Venus* was worshipped by the *Eleans*, sitting on a ram. And at *Corinth* upon the tomb of that celebrated courtesan *Lais*, a ram was engraven, as couching under the seizure of a lioness ; the meaning of which emblem is thus expressed by *Alciatus*.

*Quid sculptus sibi vult aries, quem parte leona
Unguibus appensum posteriore tenet ?
Non aliter captas quod & ipse teneret amantes ;
Vir gregis est aries ; clune tenetur amans.*

What, wou’d the ram be claw’d, whose hinder veins
With bloodless gripes a lioness constrains ?
Such to the fav’rite ewes his ardour deal,
Head of the flock, but govern’d by the tail.

This exposition is confirmed by *Erizzus* and *Pierius Valerianus* : And *Artemidorus* affirms, that to dream of a ram’s throwing a man off his back, tortells the approach of an adulterer, who shall cuckold the husband. Some of the most libidinous princes have stamped their coins with the figure of this animal, and there have been flatterers of such abandoned impudence, as to use the same device on a medal of *Antinous*, in allusion to the unnatural passion of *Hadrian* for him.

The figures, thus explained, are supported by the legs of a cock, as columns to the whole. This bird, it is confessed, from his frequent aspect to the heavens, and his rising before the sun, has been often used as the hieroglyphic of piety and vigilance. But as these virtues reside in the head, and not in the legs, which alone are represented in the stone, it would be ridiculous to apply them to the shanks of the bird. But when we consider, what these parts may properly refer to, the very reverse quality, impiety itself occurs, the ordinary employment of tyrants, and peculiar to the cock, who seldom hesitates to exercise those parts in treading his mother, and wounding his father too. For which reason the wisest legislators directed a cock, a viper, and a dog to be enclosed in the same bag with the condemned parricide, as associates in the same impiety. And *Aristophanes* introduces a wretch, who had beat his father, defending his wickedness by the example of the cock.

As

As this interpretation strictly coheres with the other figures, we find it correspond with experience also. For some tyrants have been incestuous with their sisters, mothers, and daughters too: Others have dethroned their fathers: And tho' all of them have not arrived at the same fullness of impiety, yet most of them testify very little respect for their parents or progenitors, like *Alexander*, who, as *Sallust* tells us, attempted a new path to glory, from a hatred to his father's qualities. In short, I can discern nothing wanting in this device, to furnish us with a compleat idea of a tyrant: Nevertheless, I shall not absolutely conclude, that the artist really intended by this odd jumble of heads and feet, to defigure the disposition of any prince, good or bad; For we meet with no instance of this sort either among old or modern writers. It seems more probable, that he had little farther intention, than to indulge and prosecute the absurdities of his own raving and whimsical imagination, which sort of drawings the moderns term *Grotesque*. But if we must needs discover profundity in emptiness, and, infatuated with our imaginary penetration, must conceive extraordinary sense and meaning under absurd representations, I must rather conclude, that if there is any meaning or design in this figure it must have been intended to defigure no good prince, but some virulent tyrant.

SCHOLIUM by the TRANSLATOR.

WE might very well submit this debate, wherein each party has ingeniously and learnedly supported his opposite explication, to the decision of antiquaries and medallists, saying very justly of ourselves: — *non nostrum est tantas componere lites*. It seems difficult however, not to observe, that the last decypherer of this figure has taken no notice of the ear of corn, which is undoubtedly entitled to some share of whatever meaning the device may have. Indeed it would have been very difficult, if not impossible, to have made it symbolize properly with any ill quality of a tyrant; tho' it has a very natural application to the conduct of a good prince, which tends to establish his subjects in peace and plenty. The head of a goat must have represented the lust of a tyrant less ambiguously than a weather's, or even a ram's, which may very obviously refer to the increase of flocks, and the advantages arising from it. It may well be supposed also, that all such devices are oftener intended to defigure the good, than to record the tyrant. He would scarcely have been the inventor of an emblem, that might be readily applied to his own demerit and wickedness. No subject, or rather slave, would have dared to present him with such; and probably none could think his actions either worthy the stone, or the workmanship.

The Momenta of heavy bodies upon inclined planes determined; as also the quantity of pressure sustained by two planes joined together at right angles from an incumbent spherical body; by G. G. L. From the Acta Eruditorum Ann. 1685. p. 501.

Translated from the L A T I N.

The determination of the Momenta of heavy bodies on inclin'd planes.

LET in fig. 6. plate III. the plane ADB be vertical, and the plane ACE inclined; in that let the body B have its tendency of descent, in this the body C, both which I design by the points in which their centers do exist. Let the bodies be connected by the string BAC, and be in equilibrium, and the angle ABC a right one. I say, that the body B will be to the body C as the right line AB to the right line AC; which I thus prove. Laying hold on the string, which I suppose to be without gravity, with the hand at C, and pulling downwards the body C to E and consequently raising upwards the body B to D (after which, CE and BD will be equal) 'tis plain the equilibrium that existed between the bodies, does still remain, and that the hand is neither aided nor impeded by them, and consequently, that neither is their common centre of gravity (or the centre of the whole, composed of these bodies, or the centre of equilibrium) raised or depressed: And should the common centre of gravity of the bodies in the position B, C, be in the right line BC parallel to the horizon, their centre, when in the situation DE, will remain in the line BC, otherwise it would be raised or depressed: But it is also in the right line DE, as being what joins their centre of gravity B and C, it will therefore be in H the common point of the right lines BC and DE.

Now from geometry a lemma, neither difficult nor unpleasant may be demonstrated; namely, that if CE and BD be equal, DH will be to HE, as AC to AB; of which anon. But the body E or C is also to the body D or B, as DH to HE, because H is the centre of equilibrium; therefore the body C will be to the body B, as AC to AB, which was the thing affirmed.

The same thing may also be demonstrated in a different manner, without assuming the geometrical lemma hinted at; if the body B be raised up as high as A, or if *d* fall in the point A, in that case *Ce* or *Bd* will be equal to BA, and *b* will fall in C, and *bd*, coincide, with CA; and C will be the centre of equilibrium of the bodies, transferred from B and C to A and *e*, and consequently the body in *e*, that is the body C, will be to the body in A, that is the body B, as AC to *Ce* or AB, as before. We here subjoin the demonstration of the lemma.

Lemma.

Lemma. The bases of all the triangles, having a coinciding angle and the sum of the sides about that angle equal, are cut by the base of one of the triangles in the same ratio; *viz.* the ratio of the sides of this triangle, placed about the common angle.

Lemma.

Demonstration. Let the common angle be FAM fig. 6. and let there be any number of triangles, as ABC, ADE, having the coinciding angle BAC DAE, and the sum of the sides BA + AC or DA + AE always equal (whence BD will be equal to CE) and let one of these triangles, as ABC, be assumed; I say, that by its base BC is cut the base DE of any other triangle ADE, having the above conditions, into the parts DH and HE, which are in the ratio of AC to AB: From D to AC let DG be drawn parallel to BC, and from G to BC, GL parallel to AB. Now because the triangles ABC and GLC are similar, AC is to AB, as GC to GL, or to DB or to CE. Again, because the triangles EGD and ECH are similar, GC is to CE, as DH to HE; therefore AC will be to AB, as DH to HE. Q. E. D.

From the demonstration it appears, that it matters not whether the angle B be a right one, and therefore too DE the base of the triangle ADE cuts the base BC of the other triangle ABC, having the same sum of the sides about the common angle, so that the segments CH and HB are proportional to DA and AE, the sides of the triangle ADE about the angle A, common to the triangles.

The quantity of pressure sustained by two planes at right angles, from an incumbent spherical body

We now proceed to the solution of the case about the spherical body I (fig. 7.) incumbent at the same time on the two planes XC, and ZC, on the one in F, on the other in H, inclined to the horizon NO, but making with each other a right angle; in order to determine the quantity of the *momentum*, wherewith each plane is pressed.

Demonstration.

It appears on first sight, that the body exerts a two-fold *momentum* on any one of the inclined planes; one by which it tends to descend decliningly, the other by which it presses the declining plane, both which together constitute the absolute or total *momentum* of the body. Therefore in our case, from two causes, either plane as XFC, is understood to be pressed by the spherical body I: The first, that the body I tending to descend in the line FC of the plane XFC, with a *momentum* which is to the total one, as XN to XC, it will act with the remaining *momentum*, which will be to the total one, as XC - XN to XC, on the declining plane itself XFC, by which it is sustained. But that action, tho' true and real, is notwithstanding alternative, and weakened by the presence of the other plane, which also sustains it, as shall be afterwards explained: The second cause of pressure on the plane XFC is, that the spherical body descending in the other plane ZHC with a *momentum*, which is to the total one as ZO to ZC, presses with that very *momentum* the plane XFC, directly opposing its declining descent in the line HC, and thus receiving this force of

descent.

defcent : And the same way of reasoning may be used for the other plane ZHC, and that from those two causes of pressure ; and from the first, the plane ZHC is pressed with a *momentum*, which is to the total *momentum*, as $ZC - ZO$ to ZC ; but from the second, the plane ZHC is pressed with a *momentum*, which is to the total as XN to XC . And indeed the first cause of pressure on the plane XFC, and the second on the plane ZHC, which are dissimilar, do together constitute the whole *momentum* of the spherical body ; for the spherical body presses on the plane XFC, as it is sustained thereby, and on the plane ZHC, as it is not sustained by the former. In like manner, the first cause of pressure on the plane ZHC, and the second on the plane XFC, tho' dissimilar, constitute the whole *momentum* of the body. But similar causes conjoined, as two pressures on account of sustaining, or two pressures on account of receiving, do not, taken from different partitions of the total *momentum*, integrate or complete the total *momentum*. But when by four causes of pressure taken together, the total *momentum* is twice integrated ; 'tis plain, that taken absolutely they are incompatible, nor to be compounded *cumulatively*, but only *electively* or *alternatively* ; otherwise the effect of the spherical body upon the planes would be greater than the absolute *momentum* of the whole body. But as it is manifest, that two causes in any one plane ought equally to be taken into consideration, and yet cannot be retained entire, the rule of *alternatives* is to be employed, which takes place in estimating the expectancy of gamesters, and other cases ; that is, the half of both *momenta* is to be taken, or which comes to the same thing, an arithmetical mean between them, or half the sum of both. If therefore the *momentum* of the spherical body be put unity, since the two *momenta* of pressure on the plane XFC are $\frac{XC - XN}{XC}$ and $\frac{ZO}{XC}$ (if XC and ZC be put equal) it follows that the *momentum*, wherewith in this situation the plane XFC is really pressed, will be half $\frac{XC - XN}{XC}$ + half $\frac{ZO}{XC}$, or $\frac{XC - XN + ZO}{2XC}$; and in like manner, the *momentum*, wherewith the plane ZHC is really pressed, will be half $\frac{ZC - ZO}{ZC}$ (or half $\frac{XC - ZO}{XC}$) + half $\frac{XN}{XC}$; that is, $\frac{XC - ZO + XN}{2XC}$, the sum of which 2 *momenta*, really pressing on the 2 planes, composes the total *momentum* of the spherical body, or unity. In order to try the goodness of our rule, it will be of service to consider and compare therewith the solutions of particular cases, otherwise known : As if NX be put equal to nothing, the plane XFC will be horizontal, and ZHC vertical, and the right lines XC and ZO equal ; where also according to the rule the total *momentum* will come out for the pressure on the plane

plane X F C, and nothing for the preffion on the plane Z H C. But if the right lines X N and Z O be taken equal, and consequently the angles X C N, and Z C O equal, 'tis then evident that both planes are preffed in the fame manner by the fpherical body, and therefore that half the total *momentum* is fpent on each, which alfo comes out by our rule. The method, which we have ufed, by the rule of *alternatives*, may be very ufeul in refolving other perplexed and complicated cafes, tho' it be not purely geometrical, but in fome meafure metaphyfical too; whence it may be looked on as provisional, till the fame thing can be demonftrated in another way, more geometrical and rigorous, according to the common notions. 'Tis to be obferved, that what we have determined about the preffion of each plane, only takes place, when each of them is fufficiently firm, fo as to be able to refift each one of the *alternative conatus*'s apart, whereby it is preffed: But if one of the planes be capable of refifting the leffer *conatus*, urging it, or half the fum of both, but not the greater; but the other plane fo firm, as to be able to refift each one of the two preffions, on that very account will then one of the *alternative* cafes abfolutely take place in preference to the others, and consequently the rule of the *alternatives*, which equally take place, ceafing, the former or the weaker plane would be overcome by the force of the *conatus*, to which it is unequal. This indeed is a fingular obfervation, and may ferve to diftinguifh each *alternative conatus* of nature from the *conatus*, on account of the fruitlefs effort either way, refulting from the *alternatives* refifting each other; nor therefore is, for inftance, the plane X F C to be thought to be abfolutely preffed by the *momentum* $\frac{Z O}{X C}$, becaufe it is preffed conditionally by that very *momentum*; fo as to be broken, if incapable of refifting it. For in the cafe of its being able to refift, reacting as it does, by its elastic force on the preffing body, it endeavours to throw off the load on the other plane, which if fufficiently firm, there will from the conflict, that equal diftribution arife, which we have explained; where not the four *momenta* themfelves, but *momenta* proportional to them are ufed, into which the total *momentum* is diftributed or fhared. Thefe fpeculations, as at firft fight they may feem paradoxalic (namely, that any plane can be faid to be alternatively or conditionally preffed by fome certain *momentum* or *conatus*) fo they afford pleafure in the reflection, and are fitted to illuftrate not only the mathematical, but in fome meafure the metaphyfical procefs of nature.

Some anatomical observations on the Lumbrici, or Maw-worms in the bowels, tending to demonstrate, that these are the Masques or Nymphæ of the Tænia or Tape-worm; by J. L. Frisch. From the Miscell. Berolin. Pars I. p. 46.

Translated from the LATIN.

THE whole body of the Worm consists of three parts, the skin externally, and two guts, one of which is longer than the other.

The skin is thick, and without any aperture, that I could discover, except the mouth, which is more distinct in the smaller ones, where the lips may be observed, by which it clings, like a Leech, to the guts. In the larger Worms the mouth is provided with a certain curve or hook, which is shaped like an obtuse wedge, and is very hard, by which they adhere, in such a manner, to the inner membrane of the guts, and lower orifice of the stomach, as to produce a bump, or *Callus*. The nearer the Worm is to the stomach, the larger I found the *Callus*, especially in Sows, in the midst of which the head of the Worm is fastened by its hook, lest it should be extruded from the stomach, with the frequent and copious dejections. The tail or lower part of the *Lumbricus* is solid, the cavity of the belly is not continued to the extremity of the body. There is either no fundament, or it is so strictly closed, that no excrements are to be squeez'd from it by a compression of the body. But by a slight compression a watery humour proceeds from the mouth, which fills the empty space unoccupied by the two guts, particularly, between the navel and the mouth. I call a certain ligament the navel, which is a sixth part of the length of the body distant from the mouth, and has the long gut suspended about the middle and the widest part, lest it should fall out of the watery humour it is surrounded with, into the lower space of the belly, that is less replete with moisture, and hurt its tender parts, when the Worm should be in a perpendicular situation. The long intestine is nourished, by the mediation of this navel, from the shorter one, as a kind of stomach, with the purer white juice or chyle.

I call the shortest gut a stomach, as it contains a stercoraceous fluid, and particles that savour of human excrement. It is of a black appearance, and lies smooth, without any fold or curvature.

But the long gut is more especially remarkable, and,

First, It contains a white and thicker juice.

Secondly, It adheres to the navel by its middle, where it is more full and distended.

Thirdly, each portion hanging from the navel is much longer than the cavity of the belly, and the whole Worm, wherefore it lies folded and curved

curved, like the intestines in the bodies of animals; and from the quantity of its contained fluids, it appears thinner towards the extremities, tho' without any evident aperture or orifice.

Hence such Worms as have attained near a proper maturity for a change or *metamorphosis*, are more replete with this white juice, which appears thro' their cuticle, and exhibits more external whiteness: But the smaller are more red, the natural colour of the skin prevailing.

This white gut, or principal interior part of the Worm, appears to me to be the *Tænia* or Tape-worm, which, under the disguise, and in the husk of the *Lumbricus* pursues its nutriment in an animal body, till it attains a certain accretion; when, casting its slough, it appears in its true shape, as a Butterfly emerges from the relicks of a Caterpillar or *Chrysalis*, which seems reasonable, if we consider,

First, The length of it, which is as three to one to the *Lumbricus* or Worm, when its folds and volutions are extended.

Secondly, The white colour, which is inseparable from the *Tænia*.

Thirdly, The smoothness and homogeneity of the chyle or juice.

Fourthly, The skin of the Worm, or the texture of the Husk or *exuvia*, for it springs or cleaves open, like the skin of an *Aurelia*, on the proreption of the Moth or Butterfly. I have observed many Worms destroyed by *mercury*, voided in the same manner, with a burst or lacerated surface.

Fifthly, And which most of all confirms our *hypothesis*, the skin of the Fish-worm; for if after they are separated from the fish, the insects are thrown into cold water, they split open in the same manner, and upon the rupture of the external skin, we discover the exact form of the *Tænia*.

Sixthly, We may reflect on the defective bowels and members of the *Lumbricus*, which are never wanting in a compleat animal, as the organs of generation, womb, ovary, &c. with which, especially the genital, we see the common Earth-worms are provided.

To all which may be added the resemblance of its situation with that of a *Fœtus* in the womb, which is nourished through the navel, and ejects no excrement after digestion.

A new Antiepileptic and composing Medicine. From the Breslaw Collection, An. 1713, p. 561.

Translated from the HIGH-DUTCH.

IF the following specific shall be found, upon further experience, to produce the salutary effects, which have generally attended the exhibition of it, it may undoubtedly be considered as one of the most valuable physical

LITERARY MEMOIRS

physical discoveries of the present age, since it effectually removes the most stubborn obstructions, and convulsions, restoring the regular motions of nature, and a due exercise of the animal œconomy.

The worthy discoverer and publisher of it is Mr. *Deppelius*, who in his treatise, entitled : *The Diseases and cure of the animal sensual life*, c. 2. p. 67. introduces it in the following manner :

‘ I cannot neglect, says he, communicating and recommending to my fellow-creatures, from repeated trials of my own, a medicine, which, at once taking, removes all *epileptic* distempers, with a surprising and easy operation: For the patient being readily compos’d by it into a kindly refreshing sleep, after a repose of fifteen hours or more, awakes chearful and free from a distemper, attended with such fatal consequences.’

‘ The virtue of this medicine was first discovered by an experiment tried upon one, who for a long time was afflicted with terrible convulsive fits, which had nearly deprived him of his senses: Upon taking a dose of this medicine, he slept for 30 hours together, and then awaked very chearful, having recovered his speech and sense, to the great admiration of the Physicians, and all who had formerly known him.

‘ This sure, safe and pleasant medicine is an oil, distilled from any part of an animal, in a *retort*, till it leaves no sediment, which is not effected without repeating the process 15 times successively. Of this oil the patient is to take 30 drops before the paroxysm fasting; which producing a sound sleep of several hours, removes the distemper, from which he awakes with chearfulness and ease.

The discoverer of this extraordinary medicine being already famous for the communication of several other physical *arcana*, Dr. *Job. Junkerus*, Physician to the Orphan-house at *Hall*, and Dr. *Elias Cramerus* resolved to make the experiment, and were so successful as to bring this medicinal oil to perfection in 16 weeks.

They made choice for this process of Deer’s blood, which they slowly dried, and then distilled in a retort; whereby they obtained a phlegm, a spirit and volatile salt, which they preserved a-part. The rest was distilled over for twenty times, when there remained no sediment or adust *faeces* at the bottom of the retort: In each operation they made use of a new glass. The first oil was thick, and of a disagreeable smell, and taste, but the oftener the distillation was repeated the scent was less offensive, and the taste became more agreeable and balsamick, till at last it was brought to its utmost perfection: Whereupon it was consulted how to make trial of this famous medicine, which was suspected however, on account of its sleepy operation. The first opportunity, that presented to make the experiment, was upon a Soldier, 40 years of age, who, for 6 years together, was, three days before every new and full moon, seized with an epilepsy, which had brought

brought him very low, and almost deprived him of his senses : They gave him, a little before the second paroxysm, 30 drops of the oil, which presently caused him to fall into a sound sleep, wherein he frequently sneezed, and turning himself once about, he just uttered these words : *O this is most delightful !* and having slept for 26 hours together, he awoke with a chearful countenance, a serene mind, and with an unusual good appetite ; when before his countenance was pale, his flesh loose and flabby, his mind dull and melancholy, attended with a total loss of appetite. From which time he was entirely freed from that or any other distemper, and his strength and agility increased to admiration. This was the first trial, and the effect of one single dose.

It was tried the second time on a girl of seventeen years of age, who was attacked with hysteric symptoms, from a retention of the *Menses*, and which at last degenerated into convulsions that returned every day. After the exhibition of many remedies, generally used in such cases, they gave her, at last, a little before the paroxysm, 25 drops of this oil : She presently fell into a sleep, in which she likewise sneezed, and awoke in 24 hours after, brisk, and chearful in mind and countenance ; she had a good appetite, and was free from her distemper for six months together, but neglecting the advice of being careful to procure a discharge of the *Menses*, she was seized with the same disease about the *vernal equinox*, from which she was a second time delivered by taking 25 drops of this oil : Six months after this second cure, she was attacked again through negligence, but entirely recovered by the same medicine.

They made a third experiment on a young woman of 21 years of age : She had suffered much from obstructions of the *Menses*, and had several spasmodic twitches, as well as convulsions ; but by taking one dose of 30 drops, which was attended with some sleep, sneezing, a moderate sweat and discharge of urine, she was entirely freed from the *epilepsy*, and had the *Menses* come regularly down the next day.

The fourth subject of this medicine, was a maid of 40 years old ; she had been troubled with the *epilepsy* every month for 15 years together : The cure in this case was effected with this difference, that the first dose of 30 drops did occasion no sleep, and she had the return of the *epilepsy* once more in the same month, but upon taking the second dose, and sleeping four hours after it, she was perfectly cured of the distemper.

The fifth case was an *idiopathic epilepsy* in a young man of 24 years of age ; bleeding and gentle purging being first premised, he was completely cured by a dose of 30 drops, for after he had slept for 14 hours, he awoke, and rose brisk and lively.

The sixth experiment was made on a young man of 20 years old, who by a dose of 30 drops was cured of a melancholy *delirium*, after eight hours

hours sleep. Many others, in similar cases, have also taken the same medicine, with the like success.

Yet to be ingenuous, such is the imperfection of human knowledge, that it is certain the very same medicine has sometimes been found ineffectual, which was instanced in a man of 46 years old, whose furious madness and epilepsy could not be removed with two doses of this oil, though this very case first prompted the above gentlemen to prepare it.

This medicine being exhibited to a youth of 14 years of age, who was troubled with epileptic fits, and suspected to have worms, the distemper continued upon him for a month after taking it, but then left him.

There was also a trial made on a young man of 28 years, who had been troubled with the epilepsy, from the age of seven: Having taken ten doses of this oil for ten days together, it did not cause him to sleep, tho' all that time he was free from the epilepsy: On the eleventh day, neglecting to take the remaining doses, and going about his business in the fields, the distemper returned upon him, and his father forebore to prosecute the cure, because the patient had once, when in a fit, fallen into the fire; from which time they had given over all hopes of his recovery.

In arthritic complaints this medicine has not hitherto been tried: In intermitting fevers it has been found of no benefit: It is remarkable, that when Mr. *Deppelius* had put some aniseeds into the retort, with an intent to take off the nauseous smell, the patients who took it, were, for two hours together, deprived of their sight.

The same humane and laudable motives, that incited the authors of the *Breslaw* collection, to translate the account of this medicine into *German*, have determined us to translate it into *English*, that every curious and humane person may have an opportunity of enquiring into the virtues of so simple and efficacious a medicine, as this seems to be, by the account of these learned Physicians. And it is not the least happy circumstance of it, that it is not attended with any ill consequences, altho' a judicious circumspection in the use of it ought not to be neglected: As, (1) To consider attentively, whether the epilepsy be *idiopathic* or symptomatic, as this oil is of less efficacy in the second than the first. (2.) That the material cause of the disease be first removed. (3.) That to make a sure prognostic of the cure, the operation of the medicine, as sleeping, sneezing, &c. be well observed. (4.) To remark the real cause that may obstruct the operation in a patient, the better to remove it, but not hastily to reject or condemn the medicine. And in case it should answer the end, we are bound in gratitude to Mr. *Deppelius*, as well as to the abovementioned Physicians, for their generous communication of it to the publick, rather than consulting their private lucre in it. It only remains to be observed

* *Job. Funckeri*, Disp. in aug. sistentis observationes practicas de medicina quadam efficaci in motibus naturæ exacerbatis habit. Mense. Jan. 1718.

served, that this oil causes none of the symptoms above-mentioned, as sleep, sneezing, &c. in people that are in health, nor has it any ill consequences attending it.

Of the Ossifrage, or Bone-breaking-grass. By T. Bartholin. From the Acta Hass. Vol. II. p. 126, 232. Vol. IV. p. 48.

THIS surprising plant grows in *Norway*, where it is called *Stur*, in moist places, amongst other shrubs, and about farm-houses. It has a flag leaf, with a hard stalk, and small elegant yellow or reddish flowers, like the lesser *centaury*, which the whole plant considerably resembles. 'Tis the first grass which appears in the spring, and seems chiefly for that reason to be coveted by the cattle; for as soon as other grass appears, they leave this, probably by reason of the hardness of the stalk. Creatures that feed on it grow very lean and sick, their spine becomes gibbous, which the Peasants call Back-broken, and their feet and bones become so weak, that they walk with the utmost difficulty. The farmers always keep a quantity of dry bones by them, which proves a certain antidote. They are given, broken into small bits, to the affected animals, who give them a farther comminution, with evident eagerness, and appetite. This is followed by a salivation, which discharges a great quantity of water, whence the creatures are presently relieved, and finally recovered.

Pl. IV. fig. 1

Dr. *Truebler* of *Bergen* supposes this morbid effect might proceed merely from the extreme humidity of the plant, which rises early in the spring in these cold climates, and grows in moist situations. And it appears indeed, that the dry plant had no such effect on some cattle it was given to in *Denmark*, which some have supposed to happen from the exhalation of its volatile salt. He informs us also, that two Chirurgeons had mistaken and used it for *Centaury*, without any ill consequence. But Dr. *Sim. Paulus* attributes its poisonous effects to some particles of lead and mercury blended thro' the plant, and proposes, that it may be enquired, whether such minerals are not discoverable in those soils, where it spontaneously vegetates. Such particles must certainly be acknowledged more adequate to such dissolving, colliquative effects. The same grass growing in *Friesland*, and in such moist soils too, was eat liberally by cattle, without the least ill consequence. So that 'tis very reasonable to conclude, that the qualities of this plant, as well as of some others, must be varied by the soil, the last country having few or no minerals: And those plants which the Surgeons used innocuously for *Centaury*, might be nourished by a very simple soil. Besides, the hardness and aridity of the stalks of the grass are not the great-

Scholium by the Translator.

est indication of extreme humidity in 'it, if meer humidity could be productive of such violent effects : On the other hand, 'tis a little difficult to account for the necessity of chewing and swallowing dry bones, in order to bring on a salivation, which is attributed to mineral particles ingested. The extraordinary degree of mastication necessary to prepare them for deglutition, &c. may be supposed indeed to open the salival glands sufficiently, and, as it were, to invite a discharge of such a preternatural fusion of the humours by those channells. But their jaw-bones and grinders ought to be privileged from the tender state of the other bones, to qualify them for such severe duty. Perhaps, upon the whole, we may be allowed to suppose, that this grass, upon some particular soils, is impregnated with such particles as must produce a considerable alteration in the blood, and make its *Serum* such a peculiar *Menstruum*, as to soften and affect the ossicular system particularly : That the humours are highly fused, and that the great degree of mastication these bones require, may serve to derive the preternatural liquidity and expansion of the humours, with the particles occasioning it, to the salivary glands, where they will be discharged : For this action, which is not found necessary, in erect animals, to invite the natural ascent of the mineral vapours, may be so in quadrupeds, from their horizontal conformation and extent. As for the effects, as such, of the bones themselves, which are ground and swallowed, if they should be concocted (which I can scarcely conceive them to be, by the organs of graminivorous animals, in a natural state) they may be fused to a balmy or gelatinous *Serum*, to attemper the remaining tenuity and sharpness of the rest : Or, if they are discharged through the bowels, they may then, as absorbents, imbibe and carry off some of the acrimony, in the first passages, along with them.

An Experiment of Congelation ; by Dr. S. Reisel. From the Misc. Cur. An. 2d. Obs. 177.

*I*saac Heræus, Apothecary to the Elector of *Hanover*, and a very expert Chymist, distilled the blood of a person beheaded 1669, by an alembic, and put the distilled water into two phials, containing 4 ounces each, covering them over, and exposing them to the air in an open shop, and never observed them to freeze, throughout the very severe winter that ensued, the water continuing clear and limpid. Being surpris'd at this, he took one of the phials in his hand, about the middle of *January* 1670, and after handling it a while, and laying it down again, he found it suddenly froze, the contents of the phial he had not touched remaining still unfroze. The reason of this is submitted to the curious. Was it owing to a previous intervention of heat, or to a commotion of the different atoms of the water?

The

The Pestilence cur'd by Venery. From Vincentius Fabricius. Taken from the Misc. Cur. Ann. II. Obs. 188.

Translated from the LATIN.

THE following poem contains a surprizing case that happen'd in *Holland*, when the plague rag'd there in 1636. A *Dutch* servant maid, who was then seiz'd with it, had three carbuncles, and was remov'd into a garden, where she lay with very little succour or attendance: Under which circumstances she was visited and assisted by her sweet-heart, who lay with her every night, and enjoy'd the last *intimacies, the woman recovering, and her lover remaining uninfected. *Fabricius*, highly affected with such an extraordinary occurrence, inscrib'd a relation of it, in *Latin* verse, to the famous *Salmasius*, which, for the elegance of the poem, and the surprizing subject of it, was judg'd worthy of a place in the *Miscellanea Curiosa*. And as *Boerhaave* has inserted at length the poem of *Fracastorius*, entitled *Syphilis*, in his collection of the writers on the venereal disease, we thought such authorities sufficient to countenance the following abridgment, and free translation of the only poem we have met with among the *Acta Germanica*.

THE blasting Plague thro' wretched *Belgia* flew,
And wrathful Heav'n her Guardian Pow'r withdrew:
The flagrant Air infusing caustic Breath,
Her Marts were Hospitals, their Trade was Death.
Unbury'd Heaps the thin Survivors see,
No Place exempt, nor Constitution free;
Ev'n Art expires, and Hope's among the slain,
While Horror riots with her hideous Train:
Yet while the wasteful Tyrant gluts his Rage
On either Sex, and ev'ry Rank and Age,
Immortal Love asserts her Pow'r alone,
And splits his shatter'd Arrows with her own.
Hapless or happy shall we term the Maid,
Whose artless Beauty, all her cordial Aid,
Inspir'd a dauntless Youth, with am'rous Force,
To breath his Vows to one almost a Corse;
By dread Infection, nor by Death dismay'd,
To woo, to win, and save the sinking Maid:
While Horror shock'd, and Spectres scream'd around,
She ow'd her Safety to her Lover's Wound.

M 2

Then

* Such Intercourses being not unusual in *Holland*, after their betrothing, without any Reflection on the Parties.

LITERARY MEMOIRS

Then left untaught. Posterity accuse
 The short Historian, or incurious Muse;
 A generous Poet to the World shall prove
 The healing Pow'r of death-repelling Love.

The beauteous *Ægle*, of *Batavian* Race,
 (Her Manners corresponding with her Face)
 Vy'd with the fairest Nymphs that went to shine,
 Thro' the flat Plains, or near the flow'ry *Rhine*.
 Fortun'd indeed to spring from humbler Earth,
 And strange to all the Insolence of Birth,
 The Maiden on her dow'rless Charms rely'd,
 And liv'd by serving others helpless Pride;
 But Poverty's unequal to disguise
 The sparkling Lustre of effusive Eyes;
 Tho', of the different Hearts her Beauty won,
 The *moral Charmer* wish'd to warm but one.
 Few haughty Nymphs might boast so true a Breast,
 Tho', all inflate, of Wealth and Pride possess,
 Beneath the costliest Silks and Gems they shine,
 As thro' the Dance the flowing Wantons twine.

Thyrsis and *Corydon* their Loves profess,
 With equal Fervour, but unlike Success;
 She lov'd the first ——— his youthful Down began,
 And all his vivid Bloom to promise Man.
 His comely Cheeks were ting'd with ruddy Dies,
 And sportful Spirits danc'd amidst his Eyes.
 Plain as her own his Birth and Fortunes prove,
Ægle's Ambition was Excess of Love:
 Nor poorly grateful to the Youth she fir'd,
 The generous Beauty glow'd as she inspir'd.
 What Looks and Kisses! Smiles and Vows ensu'd!
 The Sponsal, ne're revok'd, was oft renew'd.
 Yet that themselves and After-times might prove
 The matchless Pow'r of persevering Love;
 Severest Tryal! Pestilence invades,
 And blends with deadlier Fires the sick'ning Maid's.
 The caustic Atoms, with corroding Pains,
 Sting thro' her Nerves, and pierce her inmost Veins;
 Potent to fuse, and curdle, as they pass,
 Scorch the smooth Lymph, and tear the cruent Mass.

Her

Her Lips, where fragrant Graces lov'd to dwell,
 Parch'd to the Sight, were horrid to the Smell.
 Her once fair damask'd Cheeks deep-purple'd Hue
 Portends, from acrid Salts, a deadly Blue.
 Ardours, that speed to Death, her Vitals rend,
 And to her Brain the virous Fumes ascend.
 Horrors like these invok'd, and yet dismay'd,
 Accus'd, but half absolv'd the Want of Aid.
 'Midst a wide Garden from the House she lay,
 Dreaded by Night, nor visited by Day.
 She prays (she thinks) in vain, in vain she calls,
 Her Screams redoubled by the echoing Walls;
 Her Fellows only shudder at her Cries,
 And dread the Course of *Æther* whence they rise.

Thyrsis alone, her soul-felt Horrors heard,
 Rush'd to prefer the Pestilence they fear'd.
 Heav'n he accosts with almost impious Pray'r,
 ' Attack a Man, he cries, a Virgin spare;
 ' And if with perfect Justice you decree,
 ' Remit her Pangs, her Life, and finish me.
 His Rage of Woe the sinking Virgin grieves,
 And chides the Wish, the Passion that she b'lieves:
 As vainly she implores his quick Retreat,
 Unprays his Pray'rs, and trembles for his Fate;
 Round her pale Neck his closing Arms he strains,
 And grasps the Limbs where scarcely Life remains:
 He courts Contagion, he devours her Breath,
 And swallows Kisses from the Caves of Death;
 Which strange Phylacteries and Cordials prove,
 The Rage of Poyson feels the Balm of Love.
 From the dear Air his fragrant Breath exhales,
 She feels new Spirits mount in cordial Gales;
 Which brace the Heart afresh, her Fears remand,
 And whisp'ring say, her total Cure's at hand.
 The Youth's intense Affection next explores
 Her burning Boils, and pestilential Sores;
 He chaffes them gently, while he wails them much,
 And sooths them with his softest, smoothest Touch;
 (Love and Necessity had banish'd Form,
 And much he saw to dread, and more to warm)
 When *Venus* instantly the Maid inspires,
 And blends her genial with the pestal Fires;

Her

LITERARY MEMOIRS

Her humid Eyes with softer Languors melt,
 A sweet Infection *Thyrsis* saw and felt.
 Acted by thoughtless Ardour to improve
 The total Extasy of desperate Love,
 All throbbing with delirious Joy he lies,
 Deeming Possession, tho' with Death, a Prize.
 Less warm and daring seems the vent'rous Boy,
 Who swam a nightly Ocean to his Joy.
 Less if his Flame, his Fate was more deplor'd,
 The Plague relented, but the Ocean roar'd.
 While melting Damsels genial Joys approve,
 And grateful Force excuses bashful Love;
 While Beauties sigh to kindle equal Fires,
 Where fell Disease may yield to fierce Desires;
 The *Cyprian* Annals *Thyrsis* shall proclaim,
 His potent Med'cine, and stupendous Flame.

A Maid no more, but Woman all compleat,
Ægle concocts the pestilential Heat:
 Her Bloom returns, her native Warmth revives,
 Nor long, nor vainly, with the Fever strives.
 The dear Physician doubly now she loves,
 And conns the Method that her Health improves;
 Smiling, she ails, and, willing to be sure,
 Repeats her Physick, to confirm her Cure.
 At length her Health and Knowledge more compleat,
 The vanquish'd Hypocrite reveals the Cheat,
 And in her Lover's cordial Arms agrees,
 Girls shou'd be heal'd by Remedies like these.
 Thus, what might try ev'n M—D's or P—M—'s Skill;
 Where crouding Pharmacy must surely kill,
 The Plague itself was cur'd without a Groat,
 By a Prescription Love and Nature wrote.

Sacred and free from pestilential Stains,
Thyrsis, the Wonder of his Sex, remains.
 Their Story *Belgian* Chronicles may tell,
 And challenge ev'ry Clime to paralell.
 Well might the Pow'rs defend a generous Youth
 Of matchless Love, and death-despising Truth:
 The Sequel prov'd his dreadful, dear Delight,
 No transient Gust of short-liv'd Appetite:
 Soon to confirm his plighted Vow he flew,
 And fix'd, with Transport, to the Charms he knew.

A suc-

A succinct account of a prodigious appearance of Blood. From the Miscell. Berolin. Cent. II. p. 60.

Translated from the LATIN.

THERE is a pool near the village of *Sarow* by *Stargard*, called by the inhabitants, *Kessel Pfuel*, sixty feet wide, and 140 in length.

In the beginning of *August* 1724, there appeared a thick, red matter on the surface, which might be separated by hand, and brought off, like cream or gelly : But some time afterwards, upon a succession of rain and thunder, the surface became more thin and limpid, tho' it appeared as dilutely tinged with blood. At the same time the matter that was more saturately red, was drove among the adjacent rushes, and tended more to the bottom, as the moss and herbs, that germinated under water, were spread over with a reddish matter, which appeared granulous, upon dissolution, and imparted its colour to paper. After some time this redness both in the plants and in the bottom, was changed into a greenish slime, distinguished by rusty specks, which exhibited much the same appearance, as if turpentine had floated on the surface. This slime contained a multitude of small green eggs, and little broad flies of the same colour adhered to the specks, with which the rushes every where abounded. When the water sunk from the borders of the pool, the matter might be found here and there, in spots of the breadth of a hand, and two or three fingers thick, which on the surface was coloured like congealed blood, but of a dusky red beneath, and smelt like rotten fish. We should not omit, that a great number of Worms, Leeches, and small fish were in the pond.

This red matter, being rubbed on the hands, adhered so very tenaciously, as not to be scoured off with soap, tho' it disappeared spontaneously in three or four days. White and brown paper, and linnen dipped in this water, were stained with the same colour.

On reserving some of this water in a phial, within three days a granulous red matter subsided to the bottom, as tough as glew ; yet the water itself preserved its redness for fourteen days, after which it became perfectly limpid and diaphanous, but let fall a dusky reddish sediment. The water, a month after it had been drawn, exhibited a greenish froth on the surface.

In like manner, at *Stargard*, about *Whitsuntide*, the water of a fish-pond in a garden, which was covered over with duck-weed, was tinged with a manifest redness. Some little fish which had been put into it, all died as soon as the water was tinged. The rushes on the borders were sprinkled with spots, which lodged a kind of flies or *cantharides* of a light green ; and even at the distance of ten or 12 paces from the pond, the grass was
here

here and there infected with red spots, undoubtedly from the drawing and scattering the water about. Whatever plants were sprinkled with this water, withered and turned black. And about the same time, above a hundred and sixty cabbages were eaten up with a kind of rustiness, and scattered all over with black spots.

Reflections on
this strange ap-
pearance.

FROM all the relations we have received of the waters of the pond, called *Kessel Pfuel*, being converted into blood, we shall, without pretending to obtrude our sentiments to the prejudice of any others, infer the following observations.

1. That it contracted this colour by the laws of nature, as those showers, called *Bloody* do, and as well as other ponds, ditches, wells and standing waters have done: So that we may conclude very little new or extraordinary, and much less any thing miraculous in it: or (as the ages of ignorance and superstition readily might) suppose it to be portentous and denunciatory of War, or other dreadful calamities.

2. This appearance has never been observed in winter, or in the cold months, but is demonstrated by all such observations to occur in the summer season, and hottest months, as it did in the present case.

3. Though this alteration of the water might be effected in different ways, by the admixture of simple or compound bodies, animal and vegetable, Toads, Frogs, Butterflies, and other insects; from the excrements of birds and beasts in the adjacent grounds, from the infusion of putrid leaves, grass and rushes, as well as from dew diffused thro', and infected by the air, and descending again to the surface of the earth: I say, though this effect might have been produced from such a variety of causes, yet 'tis my opinion, in the present case, that we should particularly attend to the effect of Butterflies, which are to be esteemed the principal cause; these particularly, which we observed to abound with a red liquor, which they void by drops, and in which their eggs, that produce Caterpillars, are frequently contained: If any of these drops light on trees, leaves or fruit, we commonly call it a rust, or mill-dew; and from such as were emitted with eggs, small Caterpillars quickly proceed, if not prevented by cold. When any quantity therefore of these drops is received into standing water, it is often found to communicate a blood-like redness to it. And that this was the circumstance affecting the before-mentioned pool, is sufficiently confirmed from the circumstantial relation of it in the *Pomeranian* acts.

And first (to omit other particulars) as it was observable, that in some neighbouring gardens, above a hundred and sixty cabbages were destroyed by Caterpillars. Next, as both on the grass and rushes of the pond, and on the bank of the fish-pond, near *Stargard*, where they were produced, a great number of red specks or blemishes were discovered: And farther, as all the fishes in the pond, near *Stargard*, were killed with this redness of the water.

water. From which it seems evident, that this Alteration was owing to the Butterflies, and that the imaginary conversion of the water into blood was neither new nor miraculous, but depended on natural causes. Finally, as that redness was not of a long continuance, but is wont to go off by degrees, and subside towards the bottom, it happened exactly so in this case, which was effected, the sooner too, by the intervention of cold.

Yet should we by no means infer from this, that all such blood-like alterations of water must depend on these Butterflies. And even with regard to the present case, unless we were well apprized of the situation of the pond, and other circumstances, or had been present when this change occurred, and while the redness was at its height, should we venture to decide positively, upon vulgar rumour, that such an alteration depended solely on these butterflies : Since undoubtedly the like effect ought frequently to be attributed to different causes, as to a variety of matter indued with, and communicative of that colour, as we formerly specified ; or to a commonly subsequent putrefaction, which is readily effected in the summer months, in stagnant waters ; especially, if exposed to a commixture of any filth, which greatly promotes it : From whence it also happens that waters, contaminated with such a redness, contract a sudden and excessive stink. Neither can we be certain that summer exhalations, descending again with dew and rain, may not conduce to the production of such a *Phænomenon* ; which, nevertheless, it must be difficult to ascertain with much accuracy ; and which cannot be clearly known from the appearance itself. The strict investigation of such points requires a pretty intense engagement of the understanding, an accurate examination of the particular quality of the water, before it was changed, and of the different circumstances that accompanied this change, and were consequent of it ; besides, there may be necessity too for some physico-chymical experiments on the occasion ; tho' possibly the concurrence of all these may at last prove unequal to an exact and compleat knowledge of the subject.

But tho' we may not always be capable of fixing the particular causes of such mutations, we may certainly conclude they depend on natural ones : Which opinion, tho' we readily allow every person to indulge his own, we might easily support from history, and, among other proofs, if it were necessary, from a variety of observations contained in the *Wratiflaw* collections.

We can reason but little from the rushes, leather, paper, or any materials that were infected with this colour of the waters ; but an enquiry should be built upon regular experiments on the water, the day it is drawn, and which should be commenced the very day the alteration begins : Since, as we have said, putrefaction ensues on this appearance, and is sensibly increased in the summer season ; in the progress of which putrefaction, the cohesion of the parts is not only destroyed, but a new transposition, and

connection of them are produced; so that when this putrid fermentation is finished, which has been continued for some months by the solar heat, the water, with its contents, appearing simple and unchanged, is not disposed for such experiments, as may discover the true cause and mode of the alteration of it, which has been vulgarly thought a conversion of it into blood.

Of the Wall on Mount Caucasus; by T. S. Bayer. From the Commentarii Academiae Imperialis Petropolitanae, p. 425.

Translated from the LATIN.

IN the expedition undertaken by the Czar, *Peter the Great*, against *Persia*, (in which *Derbent* and the country round it submitted to him) he partly by himself, and partly by other proper persons, observed whatever was remarkable therein: Of which the principal thing that presented itself to view, was the inaccessible ridge of mount *Caucasus* fortified with towers, and seemingly, with a very strong wall; which last, as those acquainted with the country affirmed, reaches a vast way between the *Caspian* and *Euxine* Seas. From that part of the wall which was seen, one might form a judgment of the rest. This prodigious work, especially as it was built in a desert, upon the tops of such high mountains; and besides, by the accounts of the people of the country, and even from the stones it was made of, plainly appeared to be very ancient. All which so far excited the curiosity of Prince *Demetrius Cantimir* of *Moravia*, as to go himself and view its situation.

The town, from which he set out, was *Derbent*, the capital of *Schiruan* (which province extends from the river *Cyr*, to the territory of the town, from which *Dagestan*, that is a mountainous country, reaches towards *Circassia*) situated in a declivity near the sea. From thence towards the west, rises a mountain into a craggy Peak, on which is built a Castle. The way from the town to it is through the gate *Kyrclar*, and in the middle of the road, is, cut through a very hard rock, a ditch, forty fathoms long, four broad, and three deep. A hundred fathoms from the castle, lies the village *Piridmisky*, that is to say, the *Demon* or genius of *Damascenus*: For there stands a monument of one *Piridmisky*, who, they say, was the son of *Damascenus*. Prince *Cantimir* could not read the inscription which was cut in a huge stone, as the characters were coptic, and as he had no interpreter with him. In the town stands a tower to the north, built of a rougher sort of stone than any of the rest, very ancient; and the inhabitants affirmed, that here *Alexander the Great* began to lay the foundation of a city. Going down from the castle to the sea, in the north wall are the following gates; the first

first is called *Driardizi Capusi*; the second, *Kyrclar Capusi*; the third, *Babulbab* or the *Gate of Gates*, a magnificent piece of workmanship, which still retains the ancient name of the city, and is two fathoms broad, and one fathom high; the upper part of this gate does not strike off into an arch, but huge stones are placed at right angles on posts, and are not fastened with iron bands: On the gate under-ground (called *Pabulkyiamar*, i. e. the gate of the *Last Judgment*) are some figures, but it is uncertain whether they are hieroglyphics or not. There is a tradition among the people, that this gate having been built of equal height with the other gates, had gradually sunk, and whenever it will entirely do so, then shall come the general judgment. Seven *Russian** *stadia* or furlongs from the city, Prince *Cantimir* measured the wall the length of 3285 fathoms, equivalent to six furlongs, and 285 fathoms; and he adds, that it is certain that the wall reaches to the spring-heads of the river *Irhan*, in the borders of *Georgia* 450 furlongs. M. *Bayer* did not find the name of any such river in the borders of *Georgia*; therefore from the measure taken by Prince *Cantimir*, and even from the situation of the river itself, he takes it to be the river *Yori* in M. *De l'Isle's* tables, which is in 63 degrees of longitude, and $44\frac{1}{2}$ degrees of latitude. At *Derbent*, the mountains are of different heights; the highest Peak is *Schadagy*, the *Royal Mountain*, as it were, because *Nusriwanus*, son of *Kieicubat*, built a house on its top, where he sometimes retired for his pleasure. With a quadrant, Prince *Cantimir* found its height to be 18 *Stadia*; it is reckoned the next highest mountain to *Ariarat*, and is more than half covered with snow. The greatest part of the range of the mountains of *Caucasus* are steep, craggy and bushy, and sometimes there is a plain a-top. In the valleys grow vines: And in one of the villages live *Jews*, who speak *Persic* and *Hebrew*. The wall, which is continued along the tops of the mountains and over the valleys, lies now in ruins, some towers, especially those in the valleys, (not unlike the towers in *Muscovy*) together with their gates, are entire. The wall is but a *Russian* fathom thick; the stones in that country are three *Russian* ells long, and an ell thick; here are no bricks; the stones are not fastened with iron bands or with cement, only laid over each other, but so nicely cut, that hardly any joining is perceivable. Prince *Cantimir* was told by the Interpreter belonging to a Prince of *Georgia*, who lived for some time in this town, that this last prince being, by reason of a conspiracy formed against him, obliged to withdraw, set out from *Tasfifus* northwards for *Ofsetus*; and from thence he turned to *Tuchetuo*, at the foot of mount *Caucasus*, and then to *Tianetus* and *Eretus*, till after passing the craggy mountains, he came to a plain in the confines of the

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* A *Russian* furlong is called a *verst*, and contains 500 *Russian* fathoms, one of which is equal to three *Russian* Ells, and one of these is equal to $28\frac{8}{100}$ *London* inches.

the city *Schamackia* ; then he went to *Bacua*, and from thence he passed over to *Derbent* by water. Eight days journey from *Offetus*, may be seen *Caucasus* on the left, as also the ruins of the wall. In *M. De l'Isle's* tables *, on the *Euxine Sea*, under 44 degrees of latitude, and $58\frac{1}{2}$ degrees of longitude, not far from the town of *Dandarus*, are marked the traces of a wall, which run along the river *Cudurus*, from south to north, and at last turn a little to the east, 75 *Russian stadia*. Whether *M. De l'Isle* had his information of this Wall from *Soscamus Sadda*, a Prince of *Georgia*, or from *Crusius* or *Zurabecus*, it is indeed, no mean proof that this Wall reaches to both seas. *F. Archangelus Lambertus*, in his † *Iter. Ibericum*, describes the Wall (of which he gives a figure) nearly in the following manner :
 ' That it is a vast tract, and that the Wall is upwards of 600 miles
 ' in length ; that here and there it is fortified with towers, in which are
 ' Soldiers to guard them ; that the principal inhabitants of *Odiscus* send
 ' men thither every month to relieve them ; that from the sea the land
 ' rises gradually up to the highest Peak of *Caucasus* ; that the lower part of
 ' the country is partly fortified by nature and morasses, and partly by art
 ' and with wooden towers, in order to hinder any person passing that way
 ' without the Soldiers leave.'

Now from this Wall to the river (to which Prince *Cantimir* certainly found it reached from the east) is but a little way, in which the vestiges of the Wall are either quite effaced, or have not hitherto been traced. Thus far Prince *Cantimir*.

Some curious persons may be desirous to know how much of this noble monument of antiquity was discovered before *Peter the Great* went upon this expedition ; most people may complain that every particular as to the situation and course of the Wall is not entirely ascertained. As to all which, *M. Bayer* endeavours to give all the satisfaction he can.

It was latterly that the *Greeks* knew any thing of mount *Caucasus* (called by the *Scythians* *Graucasus*, from the snow upon it, it being a kind of *Alps*, as it were) and that by means of the colonies sent thither from *Pontus*. As they therefore supposed, that this mountain was situated in a distant country, as it was then reckoned, and consequently liable to fabulous relations, they believed that *Prometheus's* punishment would be the more severe, were he, according to the command of *Jupiter*, tied down to mount *Caucasus*, whither none would have ventured to come to release him, but some *Hercules* or other. *Hesiod* had only tied him down to a pillar ; but *Æschylus* was the first, as appears, who had tied him down to that mount *Caucasus*, which rises between the *Pontus* and the *Caspian* shore. *Herodotus*, as he was a native of *Halicarnassus*, and very much conversant with the King's Lieutenants in *Asia*, knew better than any other

* *Regionum vicinarum Maris Caspii*, Ann. 1723 ed.

† Dans le Recueil de Voyages au Nord. T. VII. p. 176.

other, the state of those countries, which were under the *Persian* dominion: For, in his *Euterpe*, he says, that the *Caspian* sea is 15 days journey in length and 8 in breadth, to the west of which lies mount *Caucasus*, of a vast extant and height, and inhabited by people of different nations, who paint their cloaths, but in such manner, that the figures appear interwoven, as it were, in the stuff, which is owing to the deep dye given it in the wool. This mountain (as he says in his *Thalia*) bounded the *Persian* empire, and every fifth year its inhabitants paid the King a tribute of a hundred boys and as many girls. At this time there was no part to the north of *Caucasus* under the dominion of *Persia*; and to the east of the *Caspian* sea, is a vast plain, which is known to be the seat of the *Massagetæ*. And likewise in his *Clio*, he obscurely hints at two passes through which the *Cimmerians* and *Scythians*, from different countries, and by different ways, issued out, in great numbers, into the *Greater* and *Lesser Asia*. *Caucasus* is no better known by the Expeditions of *Alexander*, the dynasty of *Lyfimachus*, or of the Kings of *Asia* and *Syria*, as their affairs are likewise involved in obscurity. *L. Lucullus*, in his expedition against *Mithridates*, was not far from that mountain. *Cn. Pompey* was the first of the *Romans*, who sat down near the passes of *Caucasus*. *Lucian*, in his *Pharsalia*, introduces *Pompey*, speaking thus:

*Si vos, O Parthi, peterem cum Caspia Claustra,
Et sequeretur duos æterni Martis Alanos,
Passus Achæmeniis late decurrere campis.*

Lib. viii. v. 222.

From that time were known two passes of *Caucasus*, the one the pass of the *Caspian* sea to the east (called *Caspia*, if we may credit *Eratosthenes*, from which likewise arises a large mountain to the east) the other, the pass * of *Caucasus*, both which passes have been confounded together, as *Pliny* observes in more than one place. Thus *Lucan* wrongly calls it *Caspia*, as *Pompey* or no *Roman* General had ever penetrated so far: For, *Pompey*, as is plain from *Appian* and *Plutarch*, after coming up with *Mithridates* at the river *Euphrates*, defeated him in a great battle in the night-time, and in the pursuit after him, he first turned to *Armenia*, and then advancing into *Albania* (situated between mount *Caucasus* and *Armenia*) he came among the *Iberi* to seek him. But *Mithridates*, as he wintered in the mean time at *Dioscurias*, after taking a compass to view the coast of the *Pontus*, fled to the coast of *Bosphorus*, and *Scythia*; this way the *Romans* must have followed him. Therefore, as is evident † from *Appian*, *Pompey* sat down in the passes of *Scythia*, thro' which no one had penetrated before; and in his return making War on the *Albani*, on account of their revolt, he afterwards turned against the *Armenians*. When he

marched

* Ap. Strab. f. 568. Ed. Henr. Petri.

† P. 400. ed. Tol.

marched to the *Caspian* sea, he was told, according to *Plutarch* *, several frightful stories, particularly of great numbers of Serpents in the way: However he sent some of his people to know the certainty of this report; and upon their bringing him some of the water of the *Caspian* sea, he found it sweet, as *Alexander the Great* had done before him, and as lately the *Russian* army found it so too. For the Waters are sweet without losing their sapor, near the shore, where the rivers disembogue. *Pliny* || likewise charges the Writers of the exploits of *Corbulo* in *Armenia*, under *Nero*, with the same error of confounding the passes of the *Caspian* sea and those of mount *Caucasus*. And next he adds, that the table of those countries, sent by *Corbulo* to *Rome*, places the passes of the *Caspian* sea where those of *Caucasus* are. *Cornelius Tacitus* † was thereby misled. *Claudius Ptolemæus* calls the passes of mount *Caucasus*, *Sarmatica*, and those of the *Caspian* sea, *Albania*; and he places them too far from the *Caspian* sea, unless perhaps he would mean the pass where the ridges of *Caucasus* first part and form a valley.

What sort of passes these were, we might learn from *Varro* (or from the Author which *Pliny* borrowed from, whether it be *M. Terentius* or *P. Atticinus*, who were both intimate friends of *Pompey*, even in his last misfortunes) I say, from *Varro*, and *M. Agrippa*, had not their commentaries been lost. Now it is uncertain how much *Pliny* borrowed from either, and how much he borrowed from *Corbulo*'s commentaries: For *Corbulo* having been very successful in *Armenia*, the *Romans* were so filled with the fame of the passes of mount *Caucasus*, that *Nero*, who was always vain-glorious, intended himself to undertake an expedition against the *Sarmata* through these passes, wrongly called *Caspian*, though as *Pliny* ‡ affirms, there was scarcely any communication open between the passes of *Caucasus* and those of the *Caspian* sea; he therefore gives an account, whether he had it from those who had been in *Pompey*'s expedition, or from some of *Corbulo*'s Soldiers; ‘that § the *Caspian* passes were a narrow way, between
‘ steep rocks, eight miles long, cut out by art; so that scarce a waggon
‘ could pass; and that on the right and left stood rocks resembling bushes;
‘ and that there was no water for 38 miles (in some copies it is only 28)
‘ and that the narrowness of the way hindered the flowing of a saltish
‘ liquor from the rocks, as also the passage of great numbers of Serpents,
‘ but in the winter.’ As to the passes of *Caucasus*, he says, ‘that a
‘ great many are very much mistaken, who call it *Caspian*, it is a prodigious work of nature, where stand steep rocks and gates secured
‘ with iron bars; underneath in the middle runs a rivulet of a strong
‘ stench, on this side, fortified with a castle, called *Cumana*, to hinder the
‘ excursions of a great many nations that way, which is shut up with a
‘ gate

* F. 638. || *Plinius e Varrone*. † *Annal. L. vi. c. 33.* ‡ *L. vi. 13.* § *L. vi. 14.*

‘ gate over against *Harmastis*, the chief city of *Iberia*, which *Ptolomey* calls *Harmaticus*.’

After that time there is nothing considerable related of the gates of *Caucasus*, and those of the *Caspian* sea, down to the time that *Constantinople* became the seat of the *Roman* empire in the east; to which *Caucasus* was nigher, and there followed frequent incursions of the barbarous nations into *Armenia*, *Asia*, and *Syria*, according to the *Greek* and *Syrian* Writers. *Claudian*, therefore, under the Emperor *Arcadius*, a little before the death of *Stilico*, speaking of the *Gothic* war, says,

*Nonne videbantur quamvis adamante rigentes,
Turribus invalidis fragiles procumbere Mari,
Ferrataeque Getis ultro se pandere Postæ?
Nec Vallum densæque Sudes arcere volantes,
Cornipedum Saltus, jamjam conscendere Puppæ
Sardoniosque habitare sinus & inhospita Cypri,
Saxa parant, Vitamque Freto spumante tueri.*

According to him, *Procopius* of *Cæsaria*, in the transactions in the east, mentions in the *Gothic** war, two gates of *Caucasus*, *Tzur*, and the gate of *Caucasus*. And in the *Persian* war, he gives a very full description of the gates of *Caucasus*; for he says, that *Taurus* of *Cilicia* runs out into *Armenia*, *Persarmenia*, *Albania* and *Iberia*, and the farther it does so, the higher it is; that beyond the confines of *Iberia*, is a very narrow path or pass 50 *stadia* long, which ends in a steep and inaccessible rock, only that nature had made a way through it, as if it had been cut by art. He affirms that that gate was called *Caspia* from time immemorial. That after going through this gate, there opens a vast plain, very well watered, and fit for feeding Horses, and that in it live the *Hunni*, as far as the *Mæotis*, and that horsemen can go this way as far as *Iberia*; but there is no going any other way without the greatest trouble, and without leaving one's Horse behind, on account of the precipices and windings of the mountains; that *Alexander the Great*, considering all this, had made a gate and built a castle over it, in order to hinder the excursions of the northern nations; where *Procopius* calls the gate of the *Caspian* sea, the gate of the *Caucasus*; this is a mistake of a great many of the ancients, as has been shewn above from *Pliny*. And this error prevailed so much among historians, that with the name, even the memory of the gates of *Caucasus* was gradually lost. But *Eustathius*† of *Thessalonica* gave the following description of the *Caspian* Gates: That the *Medes* lay to the east as far as the *Caspian* gates, which are in *Media*, and are called the key of *Asia*: And that there are mountains, or rather steep rocks like gates, which

* L. iv. c. 3.

† In parabolis Dionysianis, ad. v. 1034.

which take 'their name either from the *Caspian* sea, or from the *Caspia*: That thro' these is the way from the north into *Hircania*, and *Persia*; and that the northern nations are hindered thereby from making excursions.

It is almost in this manner that our Authors mention the passes of *Caucasus* and those of the *Caspian* sea: But no *Latin* or *Greek* Writer of all antiquity has made mention of the Wall which was drawn along mount *Caucasus*. But the *Arabians* and *Persians* mention it in their writings, as if it were a barrier made against *Gog* and *Magog*. Mr. *Hyde*, in his letter about the measures and weights of the *Chinese*, believes he had found that Wall in *China*; but in this he is mistaken. *Abulgafus Bagadur Chan*, in his *Schagjare Turki*, or genealogy of the *Turks*, speaks of the Wall of *China*: In *Arabic* it is called *Sed*, which in *Persic* is *Dir* or Gate, and in the old *Turkish*, *Chataic* or *Chinese* languages, *Unguli*. Thus erroneously did *Abulgafus* write, and more erroneously has he been translated and published in the *Russian* language, from that in *High-Dutch*, and lastly in *French*. For that * *Ungu li* is *Van li*, which signifies 10000 *Stadia*, by which name the *Chinese* call, as it were, the Walls of their kingdom: But *Abulgafus* distinguishes this Wall from that which *Alexander the Great* built to hinder the excursions of the *Jagjugi* and *Magjugi*, who †, the *Tartars* say, have noses like dogs, and have not yet touched the Brazen-Wall, but that immediately before the day of judgment they shall, according to them, break thro' it with their noses. In fine, he distinguishes this wall from that which *Nuschiruan* built over against *Schamachus* § round his kingdom.

This is the same Wall which we still find lying in ruins. The other Wall does not differ from it, only that the *Makometans* have perplexed it by a fabulous name, and other idle inventions: For when *Mahomet* in the eighteenth *Surat*, says, that *Alexander* built a Wall between two mountains, his followers have wanted to find out in what part of the world it lies. *Eledrisus* tells us a great many idle stories from the authority of *Abfalemus Alterajeman*, or the Interpreter; which last affirms, that he was sent by a certain Caliph, who in a dream had seen the Wall of *Alexander*, extending, as it were, between his own dominions and between *Gog* and *Magog*, and carefully to find out what Wall this was: That the Caliph had given him a convoy of fifty Horses, as also 5000 *Denarii*, besides a present of 10000 Drachms, and to each horseman 50000 Drachms for his pay and provision for a year; and in fine, 100 Mules to carry water and other necessaries. Who this Caliph was, neither *Abdalla Ebn Chordaba*, nor *Eledrisus*, who tells this story out of *Alsalemus*, say any thing.

* P. 118, 119. † In the *High Dutch* and *French* Translations *Jadsutz madzutz*. l. c.

§ From which the Translators without any foundation from *Abulgafus*, have made it *Nuschiruanadill Sultanum Sazaarem Schamathicæ*.

thing. But as *Alsalemus* relates, that he set out from *Sermanraia*, M. *Bayer* does from hence judge of the time. For *Motalemus*, the eighth Caliph of the *Abbasidæ*, about the beginning of his reign, which was *An. C.* 834, translated the seat of the empire from *Bagdat* to *Sermenraia*, not far from *Bagdat* upon the *Tygris*; and the succeeding Caliphs down to *Motadedus* resided in the same city. *Motadedus* *An. C.* 893, translated it again to *Bagdat*: Therefore six Caliphs, in almost 60 years, resided at *Sermenraia*; and we learn from *Albulpharagius*, that at that time resided among the *Arabians*, most of the *Greek* Commentators, among whom this *Alsalemus* *Altargjeman* is reckoned one, who set out from *Sermenraia* to *Tephblisus* with the Caliph's letters for *Isaac Eben Ishmael*, Governor of *Armenia*, from whom he had recommendatory letters to the Prince of *Alsarir*, and afterwards he came to the Prince of *Lan* and *Philaschæ*, from this last having got five guides, he in twenty-seven days came into the extreme parts of the *Besegert*. M. *Bayer* explains these obscure names in the edition published at *Rome*, in which *Eledrisus* is sadly handled and maimed of the better part. From *Tephblisus* he came to *Alsarir*, a country situated on the *Caspian* sea, and which is called *Alsarir Aldekeb* (i. e. the golden throne) where *Derbent* is reckoned to be. *Lan* seems to be a corruption of *Labgjan*, which town is in the country of *Gilan*, called *Laginum* by *Europeans*, four days journey from *Casbin*. What *Philaschæ* is, M. *Bayer* could not conjecture: But *Besegert* is the country *Besa*, or as the *Arabians* pronounce it, *Phasa*, that is, a northerly country, as it lies to the north east of *Persepolis*. Hence, he says, he found in the dark country (the silly man had never heard of *Cimmerian* darkness) for ten days journey, the air to stink so intolerably, that perfumes were hardly of any use. After a month's journey, through the places laid waste by *Gog* and *Magog*, he at length, after six days more, came to *Chacanus Otcos*, which lies adjoining to this mountain, in the opening of which is a ditch or mound. Here he viewed the Wall, which is almost two *stadia* from the town; and hence it follows that he pursued his journey thro' *Persia* and some part of *India*: For in his return he also affirms that by these towers he was led towards *Chorasanus* into *Samarcandia*. And since, according to *Abulfeda*, even the vestiges of the Wall are found at *Gihon* or *Orxanthus*, in the country of *Ilak*, from *Schalbaleg*, as far as the out-let of the valley *Alschasch*; hence *Alsalemus* seems to have borrowed the whole of this fabulous relation. Now let us with *Alsalemus* view the Wall.

The mountain lay in the valley 150 *Savada* cubits; there was an iron gate 50 cubits high, fortified with two buttresses, each of which was 25 cubits broad, projecting from the gate 10 cubits; the gate was entirely made of iron plates, covered with brass; the buttresses being 50 cubits high, were covered with a roof 120 cubits: Over this roof was another building up to the very top of the mountain, on which were two iron

wings, and on the top of each two horns over against each other ; the leaves were shut, being 50 cubits broad each, and 5 cubits thick ; the bolt was 7 cubits long and one cubit round ; this bolt was 25 cubits from the ground, and the lock was 5 cubits higher than the bolt ; the key was a cubit and a half long, with 12 handles hanging to a chain ; the lower threshold of the gate was ten cubits broad, and 100 cubits long : The governor of these towers, with ten horsemen, usually make their rounds about the gate and strike the bolt with hammers, so that not only those without the gate may hear that the guards are at hand, but likewise, that they themselves may know what is a doing : It is reported that upon clapping the ear here, one perceives the buzzing, as it were of a mighty people, who live beyond it : He affirms that a little way from this, he observed a camp that took up 10 *stadia* of ground, and two towers, near the gate, 200 cubits high, and as many cubits broad ; and that between them runs a river : That in one of them are kept tools for building a fort ; and that here are iron caldrons and other utensils, where the iron plates are made. *Alsalemus* likewise saw some of these plates upwards of a cubit in length, and a hand in height. And in fine, to conclude his ridiculous fable, he affirms that sometimes were seen on the wings of the Wall vast numbers of the nations of *Gog* and *Magog*, of whom they were so much afraid, and to oppose whom, they had built so many forts, castles and towers, all of iron and brass, and had strengthened with a Wall a mountain, that by nature was inaccessible. Would one think that these people were stout warriors ? They were no other than pigmies, two hands and a half high.

Thus the fable that took its rise from the Caliph's dream, ended in *Alsalemus's*.

Gregory of *Malatia*, the nearer he was to mount *Caucasus*, the more probable is the account he gives of the situation of the Wall, than that of *Eledrisus* the *African* : And yet his account is not without some fiction : For he relates *, that *Alexander* being entreated to build the mound of *Jagjug*, made a Wall of stones, iron and brass, which by putting fire under them became one solid stone, 12 cubits long and 8 cubits broad ; and after finishing this, came to the mound of *Babulabuad*, in the valley of *Kaphgjak*, and having dug the foundation, extended it over the mountains as far as the sea of *Constantinople*. *Kaphgjak*, is by the *Arabians*, *Persians* and even *Armenians* called *Dascht* (which *Antonius Giggæus* interprets a *Desert*, but *Goli*us a *desert plain*) and is called *Daschte Kaphgjak*. In the history of *Timurus*, *Arabsides* describes its situation in the following manner ; ‘ On the south of *Dascht* lies the sea *Colzum*, or the sea of *Constantinople*, which is stormy and noted for shipwrecks ; as also the sea *Mezri*, extending from hence to *Constantinople*. These two seas would join, did

‘ not

* P. 108.

not the mountains of *Circassia* intervene : To the east lye the confines of the kingdoms of *Chouaresmia*, *Otrard* and *Sagnak*, and after passing over other countries, it borders on *Turcestania*, the country of the *Getæ*, and extends to the confines of *China*, in the kingdoms of *Mogul* and *Chatai*. But to the north lies *Emirus* of *Siberia*, *Berar*, *Kephar*, a sandy desert and mountains : And after that, it is surrounded with a desert, where are wild beasts and fowl, which serve as game for the great : None have reached its extreme parts : To the west, border upon it, *Russia*, *Bulgaria*, and the provinces inhabited by Christians.

M. *Bayer* explains some unknown names of places, that render this description obscure. And first, to the South lies the sea *Colzum* ; *Mohammed*, *Alfraganus* (a) and others call it the *Arabic Gulph*, from a town on the coast of *Egypt*, which is the *Clysma* of *Ptolomey* ; but *Arabsiades* calls it the *Caspian* sea ; for it is common with this *Arabian* to use the most far fetched and uncommon expression. *Bernardus da Parigi*, *Angelus* (b) a *S. Josepho*, and *Meninskius* affirm that the *Persians* and *Turks* call the *Calsun* or *Colzum*, the *Caspian* sea : But Mr. *Hyde* (c) adduces the testimony of a certain *Persian*, who finds fault with his countrymen for improperly using this name. *Gregory* of *Malatia* calls the *Euxine* sea, *Colzum* : But either *Gregory* was mistaken, or this was inserted by an unskillful Transcriber. *Mezri* is not the sea of *Egypt*, but the name of a great town or city, for so they call *Mezr*. The *Circassian* mountains are *Caucasus* : It is bounded to the east by known countries, *Chouaresmia* and *Turcestania*. *Kata* is the country of the *Getæ*, as *Arabsiades* and some others call it, but most part, *Chata*, on which the Author of *Logat Mesnavi* cavilling says, that such as write it so are mistaken. That *Cataia* the ancient name of the *Getæ* lies beyond *China*. *Arabsiades* does somewhat obscurely comprise this *Cataia* and the *Mogul's* country, as far as *China*, within *Kaphgjak* : But *Tagj Altauarich Saadi Effendi* in the *Ottoman* annals, and from him the Author of *Nimetullah* or the *Persic* lexicon, say, upon the word *Turc*, that the *Catæi* and *Choteni* inhabit *Desti Kaphgjak*. *Abulgafus Bagadur Chan* in *Schagjare Turki* describes this country as being within the rivers *Tin*, *Atil* and *Jaik*. He calls it *Tanais* and *Volga*, which is called *Etel* by the Writers of *Constantinople*, and is known by the name *Jaicum*. Besides, he writes that the *Urussi*, *Olaci*, *Magjari*, and *Beskiri* dwelt in *Kaphgjak*, but that they were defeated by *Kaphgjakus*, who was son to a certain General in the army of *Ogufus* (*bun* : As he was posthumous and brought up in a hollow tree he had his name from thence ; for in the *Turkish* language, *Capschack* signifies a hollow tree : This country, as he says, was so called, because he and his posterity down to *Gangiscanus* possessed it four thousand years. Here are some fictions, particularly that

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this

(a) P. 36. (b) Vocabular. Ital. Turchesc. p. 1321. (c) Commentar. R. Abraham. Peritfol. p. 65.

this calculation of *Abulgafus* runs higher than the deluge. Yet this name of the country is very ancient and was not unknown to the *Greeks*; for when *Folybius* makes mention of the *Aspaciæ Nomadæ* between the *Tanais* and *Oxus* (a) *Ασπασιακῶν* is evident a corruption of *Kaphgjak*, and even the plain was known to *Herodotus* and *Procopius*, and *R. Abraham Peritsol.* calls it the *deserts of the continent belonging to Gomer and Magog*; and *Pliny* (b), a vast plain, and like *Egypt*.

This digression to shew the situation of this country, may not be unacceptable, as both that part of geography which is very dark, is explained, to throw a light upon history, and as at the same time is ascertained in what valleys *Gregory* places the Wall of *Gog and Magog*, and we are the more confirmed herein as he writes that it reached from *Babolabuab* to the *Euxine* sea: For *Derbent* is the modern name given it by the *Persians*, and, almost in *High-Dutch*, *Derbent* signifies the bar of a door or gate. The *Turks* call an iron gate, *demir capi*. And *Haytho* of *Armenia* says, ‘ that (c) *Miralis* is called the iron-gate, which *Alexander the Great* fortified on account of the different nations that dwell in the utmost parts of *Asia*, whom he would not have to pass into the *Greater Asia* without his leave, And that city lies on some part of the *Caspian* sea, and touches the great mountain *Cocas*.’ *Cocas* is mount *Caucasus*; but the *Arabians* call this city for the most part no otherwise than by the old name, *Babolabuab*, i. e. the gate of gates, to which *Nassireddinus Tusæus* and *Ulugbegus* of *Tartary* assign the same length and breadth, as they themselves in their tables give to *Derbent*.

As we have determined the extent and situation of this very much celebrated Wall or Mound, let us enquire into the common opinion received among the eastern nations, that *Alexander the Great* was the founder of it. We need not be surpris'd at the testimony of so many *Arabians*, *Persians*, and *Tartars*, who cannot but relate fictions, when they follow *Mahomet*, that barefaced Impostor. *Gregory* of *Malatia*, it is true, was one of the sect of the *Jacobites*, but even he takes all opportunities shamefully to flatter the *Mahometans*, and he betrays great want of judgment. *Mahomet*, in the XVIII Surat, thus represents the case; that *Dulkarnain* had, by the command of God, gone to the east, and travelling from thence, came between two mountains, where I know not what people entreated him to build a Wall to defend them against *Gog and Magog*; and that he, with their Assistance, made use of cast iron to build it; that he, besides, prophesied, that the time would come, whenever *Gog and Magog* passed this Wall, this iron bulwark should be reduced to ashes. In the mean time his followers believed all his fables: Yet here interpreters do somewhat differ. Some contend that this *Dulkarnain* was King of *Arabia Felix*, son of King *Hareth*, father of *K. Abraham*, from whom *Balcais* Queen

(a) P. 262. Ed. Gron.

(b) L. vi. c. 17.

(c) P. 9.

Queen of *Sheba*, who came to see *Solomon*, is said to be descended. But the greater (a) and better part of them think, that here *Mahomet* points at *Alexander the Great*, and there are various opinions among the learned for his being called *Dulkarnain* or *two-horned*: Yet *Mahomet* did not invent all this about *Alexander*, but foisted in several idle notions of the schools and sects of the *Jews*, *Arabians*, and *Greeks* as the chiefest things in his book. *Josephus* is the first among the *Jews*, who in three words says, that *Alexander* fortified the passes with iron-gates, whose veracity (b), how great it is in this matter, appears, M. *Bayer* thinks, from hence, that he writes, that a passage was opened to *Alexander* thro' the *Pamphilian* sea, as was the case with the *Jews* under *Moses* their leader, through the gulph of *Arabia*: 'In (c) this, says he, agree all who have writ of the exploits of *Alexander*.' What assurance! All the eastern nations relate the same thing of *Alexander*, as having built the Wall and subdued the people of *Caucasus*; and to the same purpose is what *Musladinus Sadus Schiracensis* writes in the *Gulistan*, that *Alexander* with infinite labour entered the *Cimmerian* darkness: But the *Samaritan* (d) edition of the book of *Joshua*, or chronicle of the *Jews*, published about the beginning of the eastern empire, mentions that *Alexander* subdued *India*, *Persia*, and *Biladilrum*, that is, the *Lesser Asia*, and whatever was subject to the *Roman* empire, at that time, in *Syria* and *Mesopotamia*, and likewise the other provinces; and that at that time being desirous to see the land of *Seir*, he entered into the land of darkness: 'And the *Macedonians*, says he, entered for three days journey into darkness, and afterwards became masters of the country beyond this, which they had invaded and viewed in the light.' Then it was that they saw the mountains of precious stones and of gold: For what did not they seem to see upon their sudden emerging out of darkness? Yet the *Samaritans* say nothing of that Wall. And *Hegesippus* (not the ancient) but he who borrowed a great many idle stories from the *Jews*, relates the whole matter thus: 'That the *Albani*, with the other nations, were restrained by the iron-gate which *Alexander* had built on the steep ridge of mount *Taurus*, and that they dwelt on the *Tanais*, in *Scythia*, its neighbouring parts, and the *Paulus Mæotis*, and by his contrivance were confined in a prison, as it were, so as to be hindred from making any excursions.' This was so currently received in the east, that it came to *Procopius's* ears. And (e) *Gervasius Tilberiensis* relates that in *India* is *Mons Caspius* (from which the *Caspian* sea takes its name) between which and the sea, *Gog* and *Magog*, very fierce nations, that eat both human and animal flesh raw, were shut up by *Alexander the Great*.

Now

(a) Abrahamus Ecchellen. in Chronico Orient. f. 254. (b) De Bel. Jud. L. vii. c. 29. (c) In Archæol. L. ii. c. 7. (d) M. Bayer's Edition was Golius's. (e) T. J. Script. Brunsvic. f. 911.

Now from the authentic records of the *Greeks*, it is evident that *Alexander* never undertook any expedition to this *Caucasus*. For early in the spring of Olymp. CXI. 2. he sailed from *Eleus*, and arrived at *Sigeum*, fought the battle of *Granicum* on the sixth of *Thargelion*, or the twenty-second of *May*, O. S. From thence, marching thro' *Caria*, *Phrygia*, *Lycia* and *Pamphilia*, and thro' the passes of *Cilicia* and *Taurus* in *Syria*, in the month *Maemacterion*, the same with our *October*, he fought another battle. Hence it is plain, that he had no time to undertake any expedition to *Caucasus*. After this he besieged *Tyre* for seven months and took it by storm, Olymp. CXII. 1. on the twentieth of *Hecatombæon* or *August*. After which he marched to *Egypt*, and having settled affairs on the east of the *Hellepont*, as far as this country, he returned to *Thepsacus*, Olymp. CXII. 2. in the month *Hecatombæon* or *July*. He fought a battle with the *Persian* army at *Arbela* or *Gaugamala*, in the month *Pyanepsione*, or *November*. *Darius*, after his defeat in that battle, sent his wives and the rest of his family into *Caspian Pylæ*: But *Alexander* hastened by long marches to *Persepolis*, and followed *Darius*, who was encamped in *Media*, where when *Alexander* was informed by *Ecbatana*, that neither the *Scythians* nor *Cadusii* had sent *Darius* assistance, he pursued him with a few horse in his flight into *Parthia*. Here, it is true, *Arrian* (a) writes, that *Alexander* marched from *Media* thro' the *Caspian Pylæ* into *Parthia*; but whatever those passes within *Parthia* and *Media* be, they are not the *Caspian* passes we are in search of. And this *Plutarch* (b) saw, who from thence draws an argument, that the *Iberi* could not have submitted to the *Macedonians*, as *Alexander* suddenly left *Hyrcania*. From thence he marched against the *Bactrians* and *Indians*, and after his return he died at *Babylon*. *M. Bayer* not only confutes the fable, but traces its origin. *Alexander* had sent *Zopyrion* to *Pontus* to carry on the war, who marched against the *Scythians* (c), that is, as far as the passes of *Caucasus*, and if we credit *Macrobius* (d), even against the *Borysthenitæ*. But he and 30000 men were cut to pieces. Now here we have a remarkable instance of the readiness of conjecture in former days: For according to them, the *Scythians*, *Sarmatians* and *Poles* are one and the same people: And therefore the victory obtained by the *Scythians* is ascribed to the *Poles*. The *Macedonians*, according to *Vincentius Cadlubecus*, were defeated in a great battle by the *Poles*, nay, and what is more unlikely, *Alexander* himself. And thus we lose the truth! It is not probable that of 30000 men all should be cut off, but that some few might have escaped: And whither do we think they betook themselves? They were surrounded by a dismal country and inhospitable people, and there was no hopes of returning by land through such potent nations: They therefore betook themselves to the *Caspian* sea, and

(a) *Arrian*. p. 205. Ed. Blanc. (4) p. 208. (b) In *Pompeio*, f. 637. (c) *Justinus* L. xii. 2. (d) P. 238.

and where did this carry ? Into the eastern and northern oceans. Now they rode in the harbour, when from the northern sea they came to the *Baltic*, the way was open into *Franconia*, *Saxony* and *Prussia*. For *Scandinavia*, according to the ancients, is an island. M. *Bayer* adduces one testimony from *Ravennas* the Geographer (*a*), who borrowed it from the *Greeks*. ‘ The world, says he, is bounded on the north by the above-mentioned ocean, which comes from *India*, and the *Caspian* passes, it washes the deserts of *Scythia*; then the country where we read the *Amazons* dwelt, after they came out from the mountains of *Caucasus*, afterwards the country of the *Roxolani*, *Sarmatæ*, *Scythæ*, *Rerefeni*, and *Sidesfenni* (and probably there too the *Germans* dwell) the *Danes*, *Saxons* and *Trifi*.’ He places the (*b*) *Amazons*, after coming from the mountain of *Caucasus*, near *Colchis*, and makes *Scanzia* or *Scandinavia* to be no other than an island.

But what can be grosser than such conjectures? Yet thus Authors invented history in those times, when they unhappily made use of the monuments of antiquity : Therefore *Otfridus* the Monk derives the origin of the *Franconians* and *Gotofredus Viterbiensis*, that of the *Saxons*, and *Albertus Stradensis*, even that of the *Prussians*, *Rugiani* and *Holsati* from the *Macedonians*. ‘ There it is found, says he, that the remains of the *Macedonians*, after the death of *Alexander*, were dispersed over all the world : For as *Alexander* had, by their bravery, conquered *Asia*, after his death, they durst no longer trust themselves to that country, but withdrew with 300 ships, which were all lost, except 54, of which 18 landed and took possession of *Prucia*, 12 arrived in *Rugia*, 24 in *Albia*; the people in one of which ships landed and cut down a wood beyond *Albia*, where they settled, and were afterwards found, and therefore called *Holsati*. As an improvement upon this fable, *Gobilinus* adds, that a *Demon* opened to the fugitive *Macedonians*, all the ways into *Prussia* : ‘ Those of them, says he, whom *Alexander* left in the *Caspian* mountains, and whom he could trust to guard that country, upon hearing that he was dead, were very much troubled, and considering the hatred of the inhabitants to them, despaired of returning into *Macedonia* by land : Wherefore getting ready 300 sail, they set out on the *Caspian* sea, and were long upon the Ocean in quest of settlements; but at last a storm arising, all their ships were lost except 54, of which 17 arrived at *Prucia*, and 12 in *Rugen* and on the adjoining sea coasts.’ Thus readily are fables invented and propagated !

Besides, there is another fable, from which the two abovementioned fables are derived : The *Arabians* borrowed it from the *Greek Writers*, that *Alexander* had penetrated as far as *Caucasus*; amongst these is *Dexippus* (*c*), who relates, that after gaining several victories at mount *Caucasus*,
and

(*a*) P. 293. Ed. Porcheronis. (*b*) P. 140. (*c*) Excerpta Eusebii Græca f. 57. & Cedrenus.

and the *Mæotis*, *Alexander* returned to *India*. *Diodorus Siculus* (a), as may be gathered from his fragments, has followed *Dexippus*. Other Writers only mention *Caucasus*, without taking any notice of *Mæotis*: For they call *Caucasus*, not this that *M. Bayer* has found out, but *Paropamisus*, beyond *India* and *Bactria*. The origin of this error has been shewn by *Strabo* (b), *Plutarch* (c), and *Arrian* (d), tho' the last is inaccurate in his account of the life of *Alexander*, having been misled by the authority of *Aristobulus*, who betrayed such silliness in his history, that when he recited it to *Alexander* in *Hydaspis*, he was so enraged, as to throw the book into the river, and could hardly forbear flinging the Author after it. When *Alexander* after conquering the *Bactrians*, had turned to *Sogdiana* and *Paropamisus*, the *Macedonians* bethought themselves of the *Caucasus*, they had heard mentioned on the stage at *Athens*, so as to be celebrated all over *Greece*, and in order to add to *Alexander's* glory, they called *Paropamisus*, *Caucasus*; and according to *Plutarch* took the river *Orxantus* to be *Tanais*, famous for the exploits of the *Scythians*. Now they heard, that the *Amazons* dwelt of old upon the *Tanais* and *Mæotis*: And therefore they were confounded with the exploits of *Alexander*. That a Queen of the *Amazons* came with a great retinue, in order to have children by him, and after finding herself with child, returned to *Tanais*. In *Plutarch* are several things to refute this: For what authority may be better depended upon than that of *Alexander* himself? From whose precise orders to *Antipater*, it is plain, that the King of *Scythia* offered him his daughter in marriage: And when *Onesicritus* had mentioned this of the *Amazons*, in his history, King *Lyfimachus*, who accompanied him in his expedition to *Paropamisus*, checked *Onesicritus* in his recital, with the following remarkable saying; *But where was I when this happened*. Thro' the unacquaintedness of the *Macedonians* with these countries, they were led into this mistake about *Caucasus*: For the *Greeks*, after *Herodotus's* time, as is evident, especially from the *Argonautic* Writers, *Dionysius Periegetes*, on the *Parecholæ Dionysianæ* of *Eustathius*, placed *Asia* to the north, within narrow bounds, in order to have the *Euxine* sea next to the *Caspian*, and somewhat more northerly, joining together the *Paulus Mæotis*, and the *Caspian* sea, by a channel of communication. Thus they drew *Tanais* from the east, and extended mount *Caucasus* under *Tanais* to the utmost parts thereof: Thus confounding the situation of the world, they placed the *Chorasmii* near the *Colchi* and *Scythiæ*, and gave out, that *Pharæsmenes* King of the *Chorasmii*, according to *Arrian*, offered himself, as knowing the roads on account of the nearness of that country to his own, to conduct *Alexander* in his *Pontic* and *Scythian* expeditions. *Diodorus* (e), in his description of *Asia*, reckons *Sogdia* and *Bactria*, as the last provinces to the east

(a) L. xviii. 83. (b) F. 787. (c) In *Alexandro*, f. 690, 691. (d) In *Judicis*, p. 511.
(e) L. xviii. 5.

east and north not far from *Tanais*, and he bounds *India* with *Caucasus*. He also writes (a), that *Alexander*, having in sixteen days passed *Paropamisus*, built *Alexandria* in *Caucasus*, by which a communication is opened into *Media*: He therefore had in view the *Caspian* passes, and the city of *Derbent*. From this *Caucasus* to the east, *Polybius* (b) likewise writes, that the river *Oxus* runs. Besides so great a confusion in geography, another thing, according to *Strabo*, misled the *Macedonians*; for in *Paropamisus* they found a solemn ghastly cave, which they compared with the account given of it in their *Tragedies*, and where they said *Prometheus* was tied down and released by *Hercules*; such a mistake is not to be wondered at, for in the life of *Alexander* a great many incredible things are told; so that upon the authority of their Writers, the exploits of *Hiero*, *Gelo* or *Clearchus*, are more famous, according to *Arrian*, than those of so great a Hero as *Alexander*.

Hence it evidently appears, from what this opinion took its rise; and at the same time, how it came to be reported, that *Derbent* was built by *Alexander*; for according to *Arrian* (c), in *Paropamisus* *Alexandria* was built by him. *Pliny* (d) places that town beyond *India*, the memory of which is preserved by different nations, who claim the honour of it: For the Subjects of the *Mogul* contend, that *Alexander* performed his greatest exploits and built towns in the country which they inhabit; and they instance in those places which, it is true, are now desolate, and lye in ruins: And a certain person told (e) *Nicholas Vitsenius*, that he saw eight such places in his way to *China*, through *Seleng*, not only houses cut out of the rock, but the roads strewed with rubbish. Not far from the Wall of *China* are ruins of pillars and stone-towers. The Subjects of the *Mogul* affirm that *Alexander* destroyed these towns, but in another part of the deserts of the *Mogul's* Country is the town, *Iki Burchan Koton* or *Trimingzing*, by the *Russians* called *Bogatiri*, that is, the *City of Heroes*, which they suppose to have been built by *Alexander*, and called by his name: Not that M. *Bayer* takes this to have been really the case, but that, either his name being famous all over *Asia*, has been given to towns built even in latter times, or that other Princes of the same name would have the towns which they built called so.

As to the builder of this Wall, M. *Bayer* seems rather in a matter of such obscurity to destroy the common opinion, than to give his own. Should any one contend, that the *Medes* laid the first foundation of these barriers, M. *Bayer* will not be against it: For they yielded to no people in sumptuous and magnificent buildings.

Near *Babylon* was the *Wall of Media*, 20 foot thick, 100 foot high and 20 *Parasanga* long, which was all of bricks. The ruins of *Larissa* (a) and *Mespili*, the former 100 foot high, and the latter 50; it appeared that the foundation was made of a foreign red sort of stone, the same with

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that

(a) L. xviii. 5. (b) P. 863. (c) P. 230. (d) L. vi. 23. (e) Nic. Vitsenius in *Tartarizæ Descriptione*. Noord en Oost Tartarye, tweede druk, t'Amsterdam 1705. Parte II. p. 28. (f) Xenophon in *Expedit. Cyri* L. II. c. 4.

that in the Wall of *Caucasus*, upon which was built a brick Wall. Probably too (a) the passes of *Cilicia* and *Syria* were fortified by the *Medes*, as far as the sea; from the *Medes*, the possession of these passes fell to the *Persians*: the *Persians* being subdued, these passes fell to the *Macedonians*; and their dominions extended as far as *India*, and were comprised between the *Adriatic*, the *Pontus*, and mount *Caucasus*, which formerly bounded the *Persian* empire: But there was no Wall built over mount *Caucasus* before *Seleucus Nicator's* time. If therefore the Wall was first begun by *Antiochus Soter* or *Antiochus Theus*, no wonder it is called the Wall of *Alexander*, as some things performed by his successors are ascribed to him. Under *Seleucus Callinicus* great-grand-child of *Nicator*, the power of the *Seleucidæ* was broken, and then both the *Armenians* and *Hyrceanians* raised their heads. *Josephus* (b) relates that King *Hyrceanus* commanded the *Caspian* passes under the reign of *Vespasian*; the passes of *Caucasus* were in the hands of the Kings of *Pontus*, and after *Mithridates* was subdued, were reckoned to be under the dominion of the *Romans*, yet the *Iberi* guarded them: And probably the Wall was quite broken down at that time; as no mention is made of it by those, who could not be ignorant of the passes of *Caucasus*.

When the *Mahometans*, under *Gjerai Uhan*, became masters of *Derbent* and *Anderum*, *Mubamed Anabi Akraffi*, was ordered to search the writings of the *Arabians* and *Persians*, and to write in *Turkish* the antiquities of *Dagستان*. He says, that the Wall of *Caucasus*, built by *Alexander*, was at length so effaced, that scarce any vestige of it remained. That *Cubades*, father of *Nusreuanus*, King of *Persia*, made war upon *Hacanus* King of the *Turks*, and *Hirri*, who had the kingdom of *Nucratum*, and all *Russia* under his dominion, and an army of 40000 men; that, at length, after concluding a peace, he gave his daughter in marriage to *Cubades*, and that the allied Kings agreed to build a Wall to part their dominions; but that *Cubades* being told by the angel *Gabriel* of *Alexander's* Wall, had, after clearing away the sand that covered it, built upon its foundations the south part of the Wall, and 7 years after carried on the remainder from the sea to the further parts of the city *Tibrisferan*, near 500 *Russian stadia* distant from *Derbent*, and fortified it with iron gates, so that 100 men could defend themselves against 100000; that *Cubades*, after planting Guards at the gates of both Walls, sent *Hacanus's* daughter home to her father, having kept her only one night, and returned into *Aberbeidriana* or *Media* and *Arak* or *Parthia*. Here are some things that come near the truth. As to *Acra-sius*; after touching upon the wars of the *Ephthalite Hunns*, with *Perozes*, father of *Cubades*, &c. mentions the passes of *Caucasus*, which he confounds with the *Caspian* passes. Even this is plain from *Procopius*, who writes, that (c) the passes of *Caucasus*, had successively fallen into several hands, till *Abuzucus* the *Hunn*, a very great friend to *Anastasius* and the *Romans*, possessed them, who sent an embassy to *Anastasius* to desire a certain sum of money for delivering up to the *Romans* the gates and the castle

(a) Ib. L. III. 4.

(b) De Bel. Jud. L. VII. c. 29.

(c) F. 28.

castle. *Cubades*, after *Abuzucus*'s death, turned out his sons and put in a *Persian* garrison. Afterwards in the reign of *Justinian*, *Rufinus* was sent to *Cubades* to treat of a peace, who made a grievous complaint to *Rufinus* of *Justinian*, and the *Romans*, telling him that, for the mutual advantage of himself and the *Romans*, he had taken possession of the passes of *Caucasus* (when *Anastásius* refused to buy them to save the expence of maintaining a garrison there) lest the barbarous nations should make incursions into the provinces belonging to the *Romans* and to himself, that he kept a very numerous army to guard these passes, and maintained them at his own expence without any trouble to the *Romans*. That, whilst with the one army he opposed the barbarous nations, from carrying every thing before them, in his own provinces, and in those of the *Romans*, it was unjust that the *Romans* did not cause, as there was occasion, another army to oppose them, which he would defend against any open attacks. That he had for some time desired, that the *Romans* would evacuate the *Persian* dominions, namely, all *Mesopotamia*, or if they made his provinces the seat of war, that they should ease him of the burden of maintaining another army, or at least should send an equal number of men and be at half the expence with him, to defend the passes of *Caucasus*; that a peace could not be settled, unless the *Romans* did either of the two. This *Cubades* demanded of *Rufinus*, in the fourth year of *Justinian*'s reign. A war ensued upon the *Romans* refusing to accept either conditions, and it had quite ruined the *Roman* provinces, had not *Cubades* died, and *Chosroes* been harrassed with the incursions of the *Hunns*, when *Justinian* sent Ambassadors (a) to him, he agreed to a peace, one of the conditions of which was, that unless the *Romans* thought fit to guard the passes of *Caucasus*, they should pay the *Persians* 110 *Centnars*, that is 110000 pound of gold. But the peace did not last long: For *Chosroes* (b) soon after invaded *Syria*, and took *Antioch*, where a treaty of peace was concluded with *Chosroes*, by which the *Romans* were to pay the *Persians* down a tribute of 500 *Centnars* of gold, and every year 5 *Centnars* for the maintenance of the garison of *Caucasus*. This *Chosroes* is the same the *Persians* call *Nusfriuan*, by the surname of *Chosres*; considering his power, it is not unlikely but he built this Wall; besides he reigned long to finish such a work: For, according to *Geo. Syncellus* (c), he reigned 48 years. Lastly, *Gregory Malatensis*, after relating that the Wall was built by *Alexander*, speaks thus, that the Kings of *Persia* did not give over looking out for the Wall, till *Fazdegerdus*, son of *Pabram Juri*, grandson of *Jezdegerdi*, and great grandson of *Sapor* found it; and that he began to build it with stones made of brass and lead, and yet did not finish it. In fine, that *Cosraes Nausfriuanus* carried it on over the tops of the mountains, and a mile into the sea, and secured it with iron gates, so that the country might be defended by 100 men, which could hardly be done before by 100000.

P 2

Whether

(a) F. 64. (b) F. 112. (c) F. 360.

Whether the appearance of Plants may be raised from their Salts. Extracted by T. Bartholin. From Olaus Borrichius, Acta Hass. p. 78, 79.

IN a publick promotion of Batchelors, the first candidate proposed three questions for the solution of *Olaus Borrichius*. 1. Whether the Salts of Plants were known to the Ancients? 2. Whether all Salts are of the same efficacy? 3. Whether Plants might be resuscitated from their Salts? To all which *Borrichius* answered learnedly and to satisfaction. He evinced the Ancients knowledge of Salts by citations from themselves: He denied that they were all endowed with the same virtues; and he demonstrated, from different instances, that the figure of Plants were reviviscible from their Salts, which instances I will attempt such a compendious relation of, as my memory has retained.

Quercetan observed, in a congealed *lixivium* of nettles, the representation of numbers of the like plant, with roots, leaves and stalks, so exactly delineated, that it were difficult to procure a Painter that should express them as truly.

Fannibal Barlet, a *Parisian* Chymist, shewed *P. Borellus*, and many others, a beautiful plant he raised from tartar of vitriol, as he assures us in his history of medicines.

Le Febure, formerly chief Physician to his *Britannic* Majesty, digested the lixivial Salt of tartar, first with spirit of vinegar, and afterwards with the highest rectified spirits of wine, for the space of sixteen months and upwards; when, upon subliming in a glass cucurbit, it rose surprisingly into the exact and natural resemblance of a vine, the colour excepted. *Sachsus*, in his *Ampelographia*, or account of the vine, has recorded the same appearances from tartar, to occur in the *Holstein* Laboratory.

Daniel Horstius saw the like picture of wormwood, from the Salt of the plant.

Petrus Servius, a *Roman* Physician, saw a rose-tree spring up, and produce, in twenty-four hours from the ashes, which had been previously prepared with great ingenuity and diligence.

Borrichius himself burnt to ashes the tender sprouts of cypress, from which he extracted Salt, which he put into a glass vessel, and to which after some months, he added a little phlegm of vitriol, that he might discover the form of the salt of cypress, which are soonest extracted by an acid. About the end of the month, upon inspecting the vessel more attentively, he observed the sides of it to be adorned internally, with a multitude of figures representing the dwarf cypress; and one little tree in particular, about the middle of the glass, of the height of a little finger, which was white indeed, but in all other respects, resembled the sanders tree, which being pretty tough was very tractable, and shewn continually to the Curious at *Paris*.

The

The same *Borrichius*, an excellent investigator of nature, obliged me with the sight of a very elegant shrub in the neck of a retort, which he had refuscitated from the Salt of thyme and antimony, and which resembled the stalks of that plant.

The peculiar Methods the Sieur Santerre *employed in his Paintings.*
From the Breslaw Collection. Ann. 1718. p. 730.

Translated from the HIGH-DUTCH.

1. **T**HE Sieur Santerre was so great a master in anatomy, and painted so much after nature, as to be able to correct several capital pieces of the most eminent *Italian* masters. 2. He could give his works such an air of freshness, that after 30 or 40 years, they should look as if but newly finished. 3. For this purpose he employed only four or five earth, or mineral colours; by mixing which he could, though not without some trouble, produce all the variety of colours. 4. He laid his colours on for three or four times, and, 5. Used no lake, or other colours, subject to fade and decay.

As to the procuring a lasting freshness to a piece of painting; it is the opinion of skilful Artists, whom we consulted on this occasion, that a picture in oil-colours, as in time these colours grow faint and dull, cannot long maintain its primitive beauty and freshness; gum, size, and milk-colours hold out longer, yet these at length fade too, as there is nothing but gives way to the air's impression. Nay, it may be affirmed, that a picture in oil-colours, shall, in the course of three or four days, fall short of its first beauty: Tho' it must be owned, there are others, that improve by time; for grown old, their harshness wears off, and the carnation or flesh-colour especially, looks softer and more natural than at first: Flowers on the contrary, and the like, appear more splendid and gaudy. However, much depends on the apartment where pictures are kept, and on the manner of cleaning them: For, by an apartment's being over-heated or filled with smoke, a painting suffers much, growing gradually darker, till at last quite black, as we frequently see in old pieces: Whereas a clean neat room conduces greatly to preserve a picture: When a piece of painting turns foul, the better way is to clean it often, rather than let it continue long in its dirt; as by too much rubbing, the soft and tender tints are apt to be hurt and wore off. Besides, a Painter, to have his colours lasting, should avoid painting on new painted canvas, and grinding or mixing his colours with new oil.

As to the best sort of colours: It may be affirmed, that earth-colours prove in no manner so beautiful as the sap-colours; especially in oil-paintings: Though the former having a much greater body, when ground with oil, exhale not, nor change; as sap-colours, especially indigo, do.

As

LITERARY MEMOIRS

As to the principal colours in painting; white, black, red, yellow and blue, to which some add green, are held such; though a blue may be made by a due mixture of a black and white; and a green, by a yellow black and white.

White, especially white lead prepared, or flake white, is the principal colour: But care is to be taken that it be not adulterated with lime or other things, which in time turn the white quite yellow. For black, we use sea-coal or *Cologne-earth*, chiefly in oil-colours. For red, cinnabar, common *Englisch* brown-red and copper-red; with which may be classed burnt-oaker. For yellow, light and dark-oaker, as also umbre, being the most proper in oil. For blue, ultra-marine and verditer, which last turns of a greenish cast in oil, but stands in water-colours. For green, *terre verte* or green earth, flake-green and verditer; which answer well in oil, only the last is apt to darken in time.

As to sap-colours, such are not fit to be used in oil, as they not only work foul, but prove evanid in sunshine or the air; whereas mineral colours will stand both; however, of these latter, some last longer than others; as, for instance, red than yellow; vermilion or brown-red, ground with oil, serves to impart an indelible stain to linen, preferable to the marking it with silk, which may be easily picked out. So that lake, being a sap-colour, must prove prejudicial in a picture.

How, laying on the colours several times over, may conduce to a picture's duration, is easy to account for; as the stronger and fuller a colour is laid on with the pencil, the more lasting will be the painting: For which end, several Masters have laid on their colours to a great thickness, especially in such as require being viewed at a distance. Some of the original pieces of *Rembrand* are done in this manner, with great judgment.

As to the distinguishing the *Italian*, *French*, *Dutch* and *Flemish* paintings from each other, this seems to be no difficult matter. If we observe that the *Italians* have something noble in their designs, and strong in their colouring. The *French*, a beautiful, sweet and easy invention and colouring: And the *Dutch* and *Flemish*, a plodding, laborious imitation of nature.

Whether and in what manner may the faults of a painting be discovered? We are here to make a distinction; namely, that the Artist may fail either in not duly imitating nature; or, again, in not being fully Master of the rules of his art.

From all that has been said may be seen, that the assertion, as to the duration of *Santerre's* paintings, is not without exception. Time indeed may improve, nay frequently add more beauty to a picture than the Artist himself could: Hence the best Masters have so blended their colours as that time should produce that intended effect.

However,

However, to prepare the colours for duration, and make them less liable to change, the grinding and mixing them up with clean and sweet nut-oil, instead of lintseed-oil, will contribute greatly; especially, if mineral colours be employed: Besides the advantage of varnishing a picture with a varnish, prepared with gum copal and spirit of wine; which, like the common varnish of the shops, is not liable to change. The painting in mineral colours has been practised amongst the most ancient Painters; and the celebrated *Venetian Painter Giogio*, who died in 1511 in the thirty-second year of his age, and had brought colouring to the highest perfection in his time, used for his carnations no more than 4 capital colours; by judiciously mixing which, he distinguished all sorts of complexions, ages and sexes; and he also knew how to heighten his colours that they should for a long time retain their beauty; particularly his green, which was not subject to fade, as it generally is. From *Pliny*(a) it appears, that the most famous Painters, as *Apelles*, *Echion*, *Melanthus*, and *Nicomachus* made use only of 4 earths; as the *terra melina* for white; *Sil atticum*, for blue; *sinops pontica*, for red; and *atrementum*, for black.

In the more early times, when Painting was yet in its infancy, the figures were not made out or shaded, but only the out-lines drawn with one single colour, which scarce deserved the name of colour; and when they drew or painted, they were wont to write underneath the name of the thing; such paintings were called *picture lineares* or line pictures. The first in this way was either *Philocles* or *Cleanthes*. In process of time, the art came to improve, and several colours to be employed; however, each figure in one colour only: Such pieces were called *monochromata*. *Eumarus* of *Athens* practised the painting all sorts of figures; and *Simon Cleones* invented the profile way; imitating also the veins and arteries, the folds in the drapery, and he began to give his figures above one colour: And from this time the art grew to be in great esteem. *Aristides* the *Theban*, was the first who taught to express the passions (b).

In those days the greatest performances were in water-colours, laid on high and glaring: *Apelles* softened them with covering his pieces with a thin *atramentum*, that made the picture be viewed with a more attentive eye: By this method he also preserved his Paintings from soil. And *Protegenes*, to make his colours lasting, was wont to lay them on four-fold; that if by accident or injury of time, one layer should drop off, another might present itself in its room. This was the state of the ancient Painting; what improvements have been made in it since, would carry us too far to mention: We shall only observe, that the *Flemish Painter John Van Eyck*, was the first who discovered, in the beginning of the

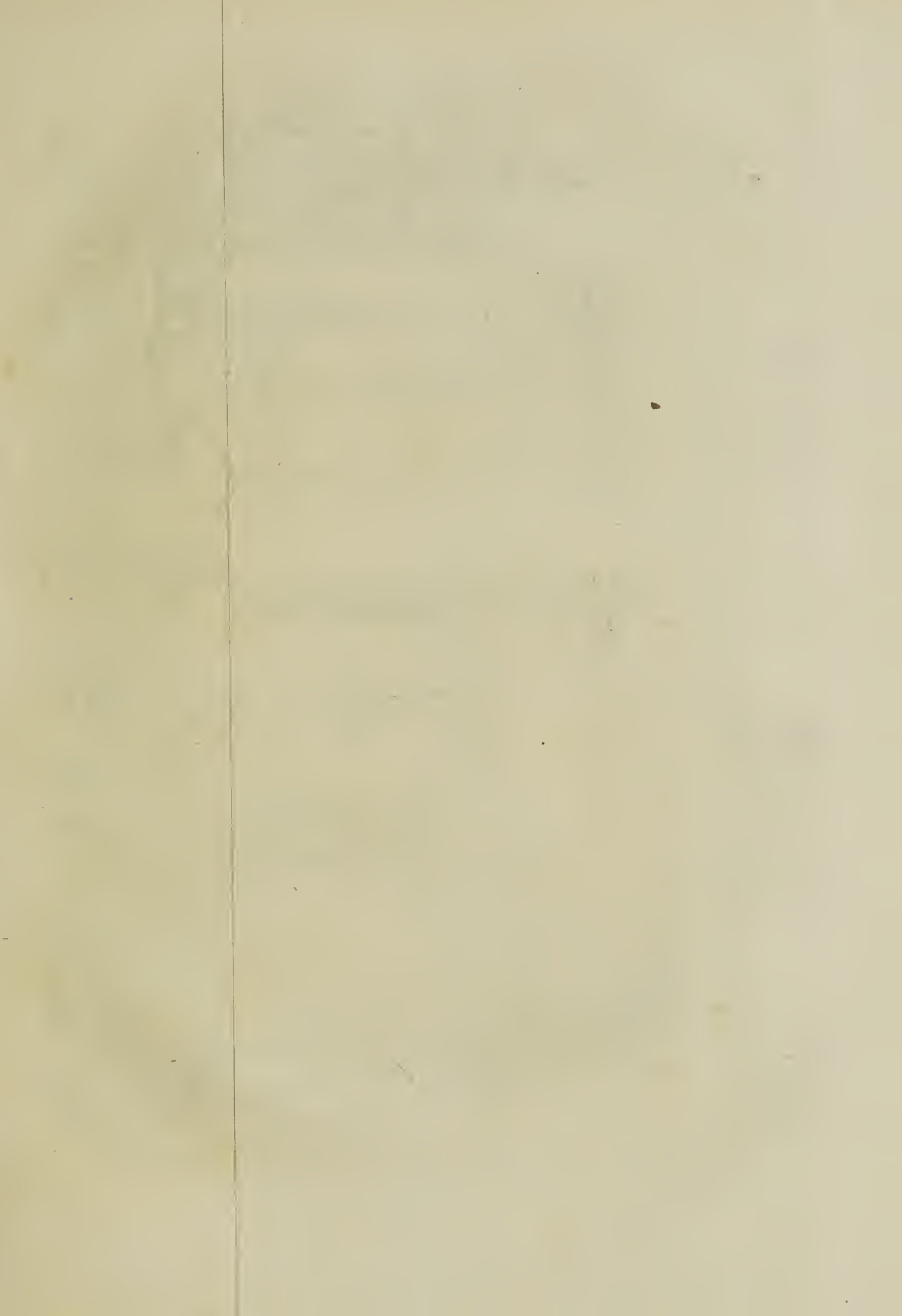
(a) Vid. Plin. Hist. Nat. L. 34. c. 12, 13. p. 594, 595. L. 35. c. 7. p. 617, 618. c. 6. p. 616, 617. Jonston. Not. regn. Min. p. 11, 12. Polymath. p. 28.
(b) Plin. Lib. 34. c. 13. Lib. 35. c. 3, 7, 8, &c.

14th Century, the way of painting in oil ; whereby Pictures come to retain their beauty for many ages together.

A practical Observation of an Inflammation of the Eye, with a Caries of the Orbit; by Con. Holtzendorf. From the Miscell. Berol. Vol. II. p. 65.

Translated from the LATIN.

A Robust, tall youth of 24 years of age, of a choleric sanguineous temperament, and addicted to pleasure, was seized in the spring with a sudden and most violent pain in the fore-part of the head, and especially raging about the *Sinus Frontales*. The blood vessels, visibly overturgid, indicated depletion, which being complied with, the severity of the pain remitted indeed ; but the third day after, the whole bulb of the Eye became unexpectedly inflam'd, and prominent, to the size of a pidgeon's egg. The *tunica adnata*, or outer coat seemed in a manner separated from the subjacent membranes, and of a reddish colour, which disease the Oculists term a *Chemosis*. The scarification recommended by *Hippocrates*, with the use of internal and external resolvents was applied for three days to no purpose ; for in the greater *canthus*, or angle of the Eye, towards, or beneath the juncture of the eyelids, we discovered a soft tumour, of the size of a large pea, from which, upon incision, a great quantity of well concocted matter was discharged. The wound being drest as usual, the suppuration continued, and even encreased to the one and twentieth day, after which time, the *pus* was succeeded by a sanious *ichor*, which indicated a corruption of the adjoining bones ; and in fact, upon searching, we found the *Os unguis* entirely carious ; when resolving to perforate it, as in the case of a *Fistula lachrymalis* it appeared, on a more accurate inquiry, before the proposed operation, that not only that part of the *coronal* bone that is joined to the *Os unguis*, but even the *Os ethmoides*, and the circular *Apophysis* of the upper jaw-bone, that forms the *maxillary sinus*, and constitutes the lower part of the orbit, proved to be corrupt, or carious. These circumstances being considered, I reflected that the pertusion of the *Os unguis*, in this case, would not only prove insufficient, but useless ; as the whole lateral, internal, and lower part of the orbit was corrupted ; so that after all, I determined to commit this difficult work to the sagacious operations of nature, only assisting the patient with regular care, and due regimen : Within a few days after we arrived at the defective and separable bones, and making an incision in the rim of the orbit, three pieces of them were successively extracted



extracted of the size of a large lentil. After this separation, the ulcer discharged a laudable *pus*, as at first, which was not only discharged by the incision, but through the channel of the nose on the same side: We had recourse to deterfivè vulnerary inspections, and after an interval of some weeks, the patient was entirely recover'd, the Eye being no ways impair'd in its use and function.

I cannot hesitate to communicate this case to the literary world, which my vanity does by no means stimulate me to do, since the cure of this disease was altogether inartificial. But I publish it to the intent, that young practitioners may not abide too abundantly in their own skill, in such desperate cases: That they may not meddle over rashly, but observing their due limits, let them reflect on the extensive operations of nature, and pay a just reverence to her laws, who so wisely superintends and directs the Operations of our bodily machines.

New Experiments in Electricity, published in 1744; by John Henry Winkler, Professor of Greek and Latin, at Leipſick.

Translated from the HIGH-DUTCH.

1. **W**HEN a piece of *Electrum* or amber is rubbed, there is a virtue excited therein, which operates on light bodies, lying near it, as chaff, sand, threads, feathers, leaf-gold, &c. in such a manner as to cause them to rush on the amber, as if forcibly pulled towards it. An Explication of the terms.

2. This virtue, excited in amber by rubbing, not only causes light bodies to fly towards it, but also repels them.

3. In like manner do sulphur, pitch, sealing-wax, glass and many other bodies manifest the same effect upon friction.

4. Yet the experiments on sulphur and glass are of a later date than those on amber, *Otho Guerick* (a) of *Magdeburg*, being the first who observed an electric virtue excited in a ball of sulphur by friction: After this discovery, many excellent persons, as *Gilbert*, *Boyle*, *Hawksbee*, *Gray*, *Du Fay*, *'s Gravesande*, *Musschenbroeck*, and others applied themselves with great care to make experiments on glass, by means of which they greatly enriched natural Philosophy.

5. Now in regard that glass and many other bodies agree with *Electrum* in this, that by friction they manifest a virtue, whereby light bodies are both attracted to, and repelled from, them, this virtue came to be

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called

(a) *Experimenta nova Magdeburgica de vacuo spatio.* c. 15.

called *Electricity*, and the body itself was said, *to be electricised or impregnated with Electricity*.

The Description
of two new Ma-
chines employed
for exciting Elec-
tricity.

6. For making the electrical experiments with glass, there has generally been employed a hollow glass-tube, which rubbed either with leather, a cloth or paper, by interposing these between one hand and the glass, and moving the glass up and down with the other.

7. But as this proves extremely tiresome, and the body thereby not in so uninterrupted a manner impregnated with Electricity, the late *Christian Augustus Hausen*, Professor of Mathematics at *Leipsick*, devised a more compendious way, providing himself with a globe which he turned round in a horizontal position, by means of a wheel. The whole apparatus is to be seen in his treatise, published in 1743, by Professor *Gottsched*, under the title of *Novi profeetus in historia Electricitatis*. The globe of this machine is the very same with that otherwise employed for producing the electrical light, as *M. Hausen* himself testifies. Professor *Wolf** relates, how *Hawksbee*, from the consideration of the light which the mercury in vacuo, exhibited upon rubbing the glass, was led to other experiments, where by means of friction on glass he produced light. The machine contrived by *Hawksbee* for this purpose, Professor *Wolf* caused to be imitated by the famous Mechanic *M. Leupold* of *Leipsick*, but with some alterations, as he shews in the above place. The construction and nature of the machine, as it was contrived by *Hawksbee* may be seen in 's*Gravesande*†. And after the same manner is *Hausen*'s machine constructed. In *Hawksbee*'s machine, as altered by *Leupold*, the globe stands vertical and the wheel horizontal; but in 's*Gravesande*'s and *Hausen*'s on the contrary, the globe lies horizontal, and the wheel hangs vertical.

8. Professor *Hausen* in his physical colleges, which he read in 1742 and 1743, had by means of his horizontal globe, not only shewn the most remarkable experiments, which in 1716 and the following years, he had seen in *England* and *France*, but had also discovered many new effects of Electricity, which he recounts in the above-cited treatise.

9. But there are some things in *Hausen*'s machine, which have given occasion to make improvements therein. For in the first place, the virtue succeeds not, if the hand, which is laid on the electrical globe, happens not to be dry: In the second place, the globe, for want of so quick a rotation, as were necessary, cannot be strongly enough rubbed: And in the last place, it proves extremely tiresome to turn round the wheel, by which the globe is moved; especially if the virtue is to be heightened, strengthened and propagated.

10. I therefore bethought me how to obviate these inconveniences; but my principal aim was to procure a machine, whereby Electricity might be excited

* Nützliche versuche der Natur und Kunst, Andere Theil §. 173. † Pars II. Tab. I. fig. 2. & 3. & Tab. II. fig. 1.

excited with all the possible dispatch, and the least trouble imaginable : Upon disclosing these my thoughts about *Hausen's* machine, as that it worked too slow and laborious, to *John Fredrick Giesing* an ingenious mechanic of *Leipfic*, he began to tell me he had for some time hit on a new sort of machine, by means of which, with the greatest ease, and a peculiar degree of dispatch, an exceeding strong Electricity might be excited. This machine is very simple, and requires no great art to imitate it.

11. It consists of three pillars or posts *bo, bp, qr*, (Plate IV. fig. 2 and 3.) which are mortised into a heavy pedestal *a*, resting on three balls ; of an iron spring *ru*, and of a glass *lmn*, cemented in wood : The iron spring is made fast in a piece of wood *r*, moveable in the hindermost pillar *qr*, in regard it sticks therein by means of a gudgeon, which may be fastened by the screw *t* : The two foremost pillars *bo* and *bp* are made firm with two cheeks *d* and *d* : On the pillar internally there is a pan *o* : Thro' the pillar *bp* there goes a screw, on which there is likewise an iron pan : On both the ends of the wooden frame, wherein the glass is cemented, there are two iron points, by means of which the glass is hung on the two pans : The glass itself is a common beer-glass ; or any other glass, which is compleatly cylindrical, may be used for the purpose, the effect proving the same. His excellency the Count of *Manteufel* had for some time entertained a surmise, whether Porcelane or China might not, instead of glass, be used for exciting Electricity ; and upon trial it was found to manifest a far stronger virtue than glass. To the iron spring there is fastened a string *ww*, slung a number of times round the long arm of the frame in *l*, and below made fast to the treadle *x*, moveable upwards and downwards on the pedestal *yz*. Behind the glass (fig. 4.) there is a small pillar *hi*, with two screws *e* and *g*, which below, by means of a screw *f*, is made firm to the internal cheek. Above, on this pillar there is a small cushion *k*, done over with leather or linen, and stuffed with wool or other soft matter, and so ordered by means of the screw *e*, as to apply close to the glass.

12. The space, thro' which the treadle is stamped down by the foot, and raised up again by means of the string, is so large, that the glass, in stamping down, turns round one and a half time ; and the iron spring pulls so strong, that the treadle, upon raising the foot from it, comes in a moment to its former height ; so that each point of the glass is in the time, in which the treadle is pulled down once and raised up again, rubbed four times against corresponding points of the cushion ; which is a very small space of time ; and in a minute the treadle may be pushed down 170 times, and thus each point of the glass applied to the cushion, be rubbed 680 times ; the remaining points on the contrary, which touch not the cushion, before the glass is moved, are in this space of time

rubbed 340 times : As the cushion has a certain breadth, each point will be so much the oftener rubbed, the more points in the cushion apply successively to the glass in turning.

13. The iron spring is so elastic, as to pull back the glass again even tho' the cushion be pretty tightly applied thereto : And thus the rubbing may be heightened or strengthened to any degree at pleasure ; and in particular it is so, upon strewing some fine scraped chalk between the glass and cushion.

14. From hence it is easy to perceive, that this machine which is formed in the manner of a Turner's lathe, is greatly preferable to *Hausen's* or *'sGravesande's* : As here we need never apprehend that the glass will become moist, upon screwing the cushion to it, or the stamping down the treadle prove so tiresome and laborious as the turning round the wheel ; besides that the velocity in turning the glass backwards and forwards is far greater than in turning round the globe : And lastly, as each point, with which the glass applies, is in a minute rubbed 680 times and another in the very same time 340, the effect is indisputably quicker and more violent, especially if the cushion be screwed on tight, and some chalk strewed between.

15. And if we would try to turn round the points of a globe, by means of a wheel, the same number of times in a minute, we should find it a very laborious task ; and to ease the labour a number of wheels must be employed, which would render the apparatus too costly and take up too much room.

16. The machine with the treadle would then at length arrive at its full perfection, could another machine be contrived, which either by help of a spring or a weight, should replace the action of the man, who stamps down the treadle with his foot.

17. As I have long observed, that thin glass tubes do, by pulling backwards and forwards in the hand, acquire an uncommon degree of Electricity, I contrived a machine, by which the same thing might be done in a more commodious and easy manner : The motion is the same, as in the foregoing, as fig. 5. shews. Under the spring of the hindmost pillar *k* I caused to fix another, as a prop or stay, which helps to push up the first after being pulled down by the motion of the foot. The glass tube (fig. 6.) is 2 *Leipsic* foot and 4 inches long ; tho' it may be taken of any length at discretion : It is $1\frac{1}{4}$ inch in diameter, and put into a wooden frame, which is 1 foot and $5\frac{1}{2}$ inches broad ; on both sides *d* and *d* it has externally iron slips, which pull up and down in a groove in both the fore-pillars *bb*, fig. 7. On the upper and under sides of the frame there are iron rings fixed *m* and *m*, to which two strings are tied, one of which is made fast to the treadle, the other to the spring. To both the fore-pillars there is fastened a
wooden

wooden cross-arch *f*, fig. 6. and in the middle thereof a screw *i*, with a half round nut, to which another may be screwed by means of two screws *bb*: Both the nuts are lined with leather and wool, and so firmly applied as the glass can bear. When the cross-arch with the two half-round nuts are fixed in their proper places, the frame with the glass tube is fastened in such a manner to both the strings, as that the treadle comes to be compleatly pulled upwards by the spring, but the frame not to run against the upper cross bar *c* (fig. 5 and 7.) of both the pullies *bb*, that the glass may not be shivered by the jogging: After giving the frame this position, the cross-arch is screwed on the pillars almost to the end of the frame. The length of the tube from this place must thus be somewhat greater than the length of the space, in which the treadle is stamped down, that the upper side of the frame may not run against the nuts. It also hence appears how large the space must be, both above and below the tube, quite to the cross-bar of the pillars.

18. This machine is in like manner well fitted to rub a tube with ease, quickness and strength: Yet the first has the preference; for in the time that the treadle is stamped down, and again pulled upwards, no point of the lining on which the glass lies, before the motion is begun, rubs above twice. Whereas in the first machine, the points of the glass, resting on those of the cushion, before the motion is begun, are in the abovementioned time, rubbed 4 times. Besides, that in this last machine the Electricity is also lessened, because the lining encompasses the whole tube: For I found by the first machine, that the Electricity is by far not so strong, when the cushion covers half the glass, as when it is smaller, a cushion touching the glass in a narrow width producing the best effect.

19. The Electricity, that takes its rise from no other thing, is called the *original Electricity*. The Original Electricity.

20. This Electricity is generally excited by rubbing; which, as was already mentioned, is fitly done by means of leather, nay cloth, linen, paper, wood, cork, chalk, lead, iron and other metals.

21. The thinner the glass, the sooner is it excited to electricity.

22. Upon warming the glass and then rubbing it, the effect proves the quicker and stronger.

23. With bare warmth alone I could never excite any Electricity, whether the glass-tube were warmed over glowing coals or in the sun: And those, who tell us that by bare warmth they have impregnated bodies with Electricity, at the same time assure us, that the effect or virtue proved extreme weak.

24. On the contrary, I have often found that sticks of sulphur have for months together, after they were cast, manifested a remarkable Electricity on leaf-gold, tho' I never warmed nor rubbed the sticks.

25. Among the bodies, which bear rubbing, I have by friction on wood, leather, hempen ropes, metals, and my own skin, been sometimes unable to excite any Electricity.

26. I have at times observed, that the original Electricity has become weaker, when the glass has, by the long rubbing on the machine, been over-heated: Yet I would not from hence conclude, that an over-vehement heating always lessens the Electricity. 'Tis necessary that this be often tried.

27. 'sGravesande* pretends, when the glass-tube happens to be rubbed the contrary way to what it was begun to be rubbed at first, the Electricity ceases to be sensible, but I have found the Electricity the same, which way soever, by shifting hands, the tube was rubbed.

The Circumstances wherein the propagated Electricity becomes observable

28. Electricity bears being propagated from an excited body to another without mutual contact.

29. But there are certain matters, on which the body must rest, to make the propagated Electricity observable. In particular, I have experienced, that the propagated Electricity has a strong effect, when the bodies, to which it is communicated, lie upon pitch and blue-died silks; as also, when the bodies lie upon sealing-wax, sulphur, black cloth, white linen, porcelane, and raw-silk.

30. The communicated Electricity ceases instantaneously to be sensible, upon touching the impregnated body with the hand, with wood, iron or hemp, either in the middle or end of the body.

31. And thus to render the propagated Electricity instantaneously perceptible, I place the body on blue silk strings; if the body prove long, on blue silk strings extended over the two frames *cc* (fig. 9.) placed on the stands *dd*, to be raised and lowered, as occasion shall require: And I cause a man tread on the silken strings, wherewith the square frame represented fig. 8. is strung, and which are covered with boards, but these not to touch the wooden sides of the square frame.

32. After that the glass is sufficiently done on the machine, the communicated Electricity however proves effectual, even though a tin-rod rests on wood and metal, or is touched by men. M. *Holloweg* was the first who tried this with the new machine, at *Gotha*, when the Electricity was excited so strong, as to manifest its force, in whatever part the excited rod were laid on. In an especial manner the communicated Electricity shows itself in a wooden pole, done over with pitch, and resting on wood.

33. The

* *Phyices Element. Mathemat.* §. 555.

33. The leaf-gold, the pieces of paper, the file-chips, or sand-corns, which we would have put into motion, either by the original or the propagated Electricity, are laid on smooth and dry bodies; for if the surface proves wet and rough, these light bodies adhere thereto in such a manner as not to be easily propelled by the Electricity.

34. Some, who have writ on Electricity, pretend, that to succeed in electrical experiments, there is necessary a certain sort of weather; as that the heavens be clear, the air dry, the warmth moderate, and the wind northerly; a moist air, a keen cold and great heat being supposed contrary to the electric effects; whence these succeed not equally at all seasons: and therefore in winter a room moderately warm; in summer, a cool place, is to be chose for the purpose. In particular, that the electrical experiments answered but indifferently, when the room happened to be full of people, that perspired much, and whose cloaths smelt strong of tobacco.

35. But by my machine, not any one of these things proved any impediment; the trials equally succeeding, whether made in a dry or moist air, in heat or cold, morning or evening, in a northerly or southerly wind, or even in a storm, or in rooms full of tobacco-smoke: Only I have observed that in a cold room, a longer time is required to warm the glass by rubbing, than in a warm room; but once warmed, it fails neither in strength nor velocity of electric virtue. 'Tis true indeed, the air must not be so moist as to wet the glass: In too great a degree of heat, the virtue begins only to be weak, when the glass is long rubbed; being over-heated on account of the warmth in the air.

36. Upon suspending a hollow glass globe *bab* (fig. 11.) by its gudgeons in the pans between the two pillars *dd* of the electric machine, and fixing to the sides of the pillars an arch *dcd*, from which hang perpendicularly downwards several threads *eeee*, at a certain distance from the globe; the threads, so soon as excited to Electricity, move towards it and become horizontal; and this happens, even though the globe be quite exhausted of air: This trial I have, with care, repeatedly made, because 'sGravesande * denies any such effect in the last case. The exhausted globe does also communicate its Electricity to other bodies, with the same strength and velocity, as when full of air.

37. In some bodies, which being excited by rubbing, we observe, that it is only in a very small degree, an Electricity is communicated to them: The Bodies wherein Electricity bears being propagated. Of this sort is raw-silk, but especially among the dressed, the blue: A string of that sort being rubbed, the Electricity proves very sensible: Whereas I could never observe, that the Electricity had any effect on it, were the glass, on which the blue silk string was laid, never so violently excited.

38. Among

* Physic. Elemen. §. 559.

38. Among the bodies, wherein Electricity is excited both with and without rubbing, we reckon pitch, glass, sealing-wax, sulphur.

39. The firm bodies (§. 25.) which I could not excite to Electricity by friction, bear the having it very easily communicated; as do also animals, whether living or dead; metals, cold or warm and glowing; also herbs or trees, green or dry.

40. Not only does the excited glass communicate Electricity to certain bodies, lying at a certain distance therefrom; but among these some propagate the communicated Electricity to others.

Of all it cannot absolutely be said: For I could never yet propagate from a stick of wax, into a wooden and metallic rod fastened thereto, the Electricity it acquired from an excited glass.

41. Fluid matters bear being excited in such a manner, as to propagate the communicated Electricity to other bodies.

Bind, for instance, a hempen rope over the blue silk strings of the stand (fig. 10.) and set it against the glass on the machine, the remaining rope is in like manner laid over the blue silk strings of another stand, in a vessel either full of water, milk, beer, quick-silver, or brandy, but the rope not to touch the sides of the vessel; and the vessel to stand on the blue silk strings over the square frame, fig. 8. or on pitch. At a wide distance from this rope, there is another, hung in the water, and in like manner laid over blue silk strings on a stand, so that its end no where touches the wood. Instead of this other rope may a wooden staff be taken, and bound on blue silk strings, so as with its end to touch the surface of the water: Or a man may step upon a square frame fitted with blue silk threads, and hold either his hand or foot, or a staff in the water: So soon as the glass on the machine is excited, the end of the other rope, or wooden pole, or the other hand of the man, or his cloaths, manifest Electricity on the leaf-gold.

42. As water bears being excited to Electricity, which it propagates to other bodies, so this Electricity comes to be propagated in a wet blue silk string in a very remarkable degree, tho' otherwise not very observable when the string is dry (§ 37.)

When therefore the silken strings, which are stretched over the frame, fig. 8. become wet, there is observable in the man, who stands thereon, either no Electricity at all, or a very small degree thereof, tho' the glass copiously imparts Electricity to the man

43. Glowing coals, the flame of a candle, and burning spirits have in like manner Electricity communicated to, and propagated by, them.

With the flame of a candle I have made the trial two ways: There is set to burn in a long vessel, between two iron-bars, one of which lies in the confines of the excited glass on silken strings, as does the other also on the like strings, some lighted spirits of wine: The bars
must

The bars must neither be so near each other, nor the metalline vessel, as that either the Electricity can go from the one to the other bar, or from the one bar to the vessel, and from this to the other bar: This you try, before the spirit of wine is kindled: and as one bar is excited, without the other's being so in the least, the spirit of wine is lighted; and in an instant the Electricity becomes observable on the extreme end of the other. But the vessel with the spirit of wine must also rest on blew silk strings: If it stands on wood, which lies not on pitch, or blue silk strings, or other matters, which may be used instead of strings, the effect succeeds not.

The flame of a candle, whether of tallow or wax in a candle-stick, standing on the blew silk strings of the stand fig. 16 near the excited glass is so strongly impregnated with Electricity, as to communicate it to a tin tube, resting on the blew silk strings of the stand fig. 15. and above an ell distant from the flame.

44. I have observ'd no Electricity in the sun-beams falling thro' a hole in a darkened room upon an excited tin tube, and from this last upon a man, standing on blew silk strings: neither do the rays, falling from the excited bar, move or affect the leaf gold; nor does the man, who is enlightened by these beams, excite in the leaf-gold an electric motion.

45. Whether the rays in the *focus* of an excited burning-glass manifest an Electricity, is what I have not been able to examine, as not having had a glass, that throws its *focus* to such a distance from it, as not to give suspicion, that the Electricity of the burning-glass, reached quite thereto, when an iron bar is laid on blew silk strings therein.

46. Even snow and ice may have Electricity imparted to them, and then they excite it in other bodies.

47. Sand, leaf-gold and other light bodies, which lie on metals, on glass and smooth wood, are raised upwards with a great degree of velocity and repelled sideways, so soon as the metals, the glass and the smooth wood are excited. The motion arising by means of Electricity.

48. The motes in a sun-beam, passing into a darkened room over an excited bar, lying on blew silk strings, come into a variety of motions; some, which touch the bar either above, below, or on the sides being repelled; others again, which either move over it or to the sides, swiftly rushing towards it, are again repelled; whereby, amidst the various motions of these motes, there are varieties of curves produced.

49. A needle, hanging perpendicularly at rest by a thread near a tin tube, lying on blew silk strings, at the distance of one or more inches, comes instantly out of its state of rest, when the tube is excited; goes towards the tube, but returns back again, so soon as it touches it. Both motions are uniform, like the vibrations of the pendulum of a clock.

50. Upon counterpoising in a ballance two equal weights; the weight lying at no great distance from the excited tin tube, comes to be moved: if one of the weights be hung over the tube, the weight is made to

descend and again ascend; if under the tube, to mount up and come down again: In both cases the rising and falling lasts so long as the tube is excited: and the intermediate times are constantly one and the same.

51. We have the following Phænomena from drops of water, dropt on the *Semen Lycopodii* or seed of wolfs-claw. This seed is disposed of on a smooth board or wooden ruler: the drop is so let fall on the seed, as only underneath to unite therewith: so soon as the ruler is, by means of the glass, excited to Electricity, the seeds come to fly off gradually, some of them to the sides of the water-drop; others having ascended almost perpendicularly upwards, to fall back again on the water-drop, so as to cover it quite round; and the drop being now of a full round, and excited, and a finger or firm body held over it; by the approach of the body or finger, it comes to lose its roundness and acquire an oval form, whose point is turned towards the finger or body. If you divide it into two drops, covered equally thick with the seed, and touching each other, in the act of exciting to Electricity, they remove from each other, without holding any thing against them, and come together again, upon the Electricity of the ruler ceasing. If the divided drops happen to be very small, they are by means of the Electricity, communicated to the ruler, driven away from it in the air, in like manner as the seeds.

52. A drop of water on a wooden or metalline pin, which tapers somewhat, is changed to a compleat cone, whose base is on the pin, when this last is by its length directed towards the earth, and has been excited to Electricity. On the contrary, a drop on a tin tube, becomes not conical, 'till a finger or other body is held against it.

53. A flash of water, issuing out of a glass siphon or crane, in a right line, is by the Electricity of a second body bent or incurvated.

The experiment is as follows: The siphon *ab c*, fig. 10. 11. is bent, and a line in diameter: the short end *bc* is dipt in a vessel with water *c d e*, on an elevated part, near the tin tube *fg*, which is to be excited to Electricity. The vessel is placed and raised in a twofold manner: (1) so as that the flash, issuing out by the long part *ab* of the siphon, slips over the tube fig. 11. (2) passes underneath it fig. 10. Upon which the tube is excited to Electricity, and instantly the flash of water loses its right-line direction; and passing under the tube fig. 10. it now becomes bent upwards towards *i*; but over the tube fig. 11. it bends downwards towards *i*. In both cases it divides into smaller flashes, which are pushed quite to the tube. If the tube be touched, the flash assumes its former course: If you put oil into a tea-spoon, and hold it under the cross bar of the bow of the sword, fig. 4, it will be at times driven upwards in one continued curve line, against the vessel.

54. On the contrary a sun-beam, passing thro' a small hole into a darkened room, either over or under a tin tube, after being excited, will not swerve by that Electricity from its right-line course.

55. When

55. When the glass or glass-globe is full of air, and rubbed on the cushion of the machine, there appears in the place, where the cushion applies, on the external surface of the globe, a light. If instead of the cushion you lay the hand on the glass or globe, the light in like manner shews itself in the part, where the glass or globe is touched.

The light of bodies, excited to Electricity.

56. On the corners and points of bodies, as for instance, a sword, a crust of bread, there issue out in the time they are excited, shining beams in right lines, removing still wider from one another the farther they are produced.

If a star, fig. 8. with eight metalline and pointed rays be by means of a stalk put into the hollow tube of a metalline candlestick, and the star be turned round, so as to continue its circular motion, there appears in the dark a shining Wheel, so long as the star moves in the candlestick on the excited glass.

57. The rays issuing out at the points, all the time they are excited, are produced so quick one after another, as not to be interrupted by any motion of the air, or blowing with the mouth.

58. When the points of the star are too near each other, they cannot by the exciting be brought to shine forth all at once: Thus also on an excited saw, very few teeth do shine together.

59. From this light, which arises of itself on the corners and points of an excited body, we are to distinguish that which arises, upon holding an unexcited body against one excited: This last light appears between both bodies and touches both: 'Tis perceived, upon holding, in the dark, a finger at a certain distance, against the excited glass on the machine, or against excited wood, or excited ice and excited snow.

60. In particular the cloaths of an excited man shine strong in the dark, upon passing over them with a finger or with the whole hand, yet without touching them: If one continue in the due distance, at which the light was once found to be the strongest, he may with the finger for a considerable length draw a streak of light, almost as broad as the finger: And if the whole hand be nimbly moved on the cloaths, there will one field, as it were, after another come to be enlightened: Could such a light be produced at once on the whole surface of the man, his appearance would be uncommonly agreeable to the beholders eyes.

61. Upon holding an unexcited body against a shining point, the issuing ray becomes longer and more compleat.

62. As the star, turned round, represents with the rays of its excited points a circle of light, so a single point moved lengthwise forwards, describes a shining right line.

This is performed with the instrument, represented fig. 18. In the tube there is a wire-spring, which by the two ends *a* and *b* is included in wood: On the end *b* there is a thread, whereby it may be drawn together;

and on the end *a* fixt a sharp pin. This instrument is held parallel to an excited tin tube, at the distance of about two or three inches, and the spring drawn together with the thread: so soon as you observe on the point of the pin a light, the thread is dropt: as you pass along, the light on the point describes a right line.

This instrument and the star were in like manner contrived by the above mentioned *Giessing*,

The Electrical
sparks.

63. From some excited bodies there proceeds for a certain distance to others unexcited, a light, which is reflected from the latter to the former, and in the reflexion snaps; and which upon touching the skin of a man or beast is felt with a smarting: This snapping light is call'd the *electrical Sparks*.

64. Upon holding against excited wood, porcelane, sealing-wax, cloth, ice, and against excited sulphur, hemp and snow, a finger, or other body, I have, 'tis true, perceived a light, but could observe no sparks.

65. So, that we have two sorts of electrical lights: the one consisting in a bare shining; the other, in sparks. The former is produced in a twofold manner; either of itself, or by the approach of a body: The sparks on the contrary never make their appearance of themselves: the light of the first species causes in some bodies, as glass, porcelane, wood, both a rushing noise and a crackling.

66. Among the bodies, on which the electrical sparks may be excited, we are to reckon metals, the skin and flesh of men and of living and dead beasts, flint-stones, chalk, diamonds, quicksilver, spirit of wine, water, vinegar, milk, cheese, butter: Yet the sparks vary in strength: The most vehement are produced of metals. and men: The electrical sparks of a flint-stone are not stronger than those of butter, or milk, or water.

67. The electrical sparks only arise, when both bodies, between which they are produced, are of a nature, capable of giving forth such sparks. Thus may, for instance, either an excited man move up to one unexcited, or this to that; and in both cases there arise sparks. Should on the contrary an excited man move his fingers towards unexcited wood, or an unexcited man towards excited wood, no sparks arise.

68. The electric sparks produce in both bodies, between which they arise, a strong motion.

This at first comes to be observable on the threads, which hang on bodies, that in the act of exciting give forth sparks. For so soon as the sparks of an excited tin tube proceed to another body and are reflected, the thread on the tube is moved, whether it be nigh to, or far from, the part, where the sparks arise. Again, both the persons, between whom the electric sparks arise, feel at the same time a smarting in the skin.

69. When two bodies, which are capable of giving forth electric sparks, are excited equally strong, they give none at all.

70. But

70. But if excited unequally strong, there are then sparks produced.

For instance, if you lay two iron rods in a right line on blew silk strings, at such a distance from one another, as is necessary for producing sparks, between them: no sooner is the one excited, on the glass of the machine, than between it and the other there are sparks produced: The other rod is not only thereby excited, but obtains also, as it lies on blew silk, the communicated Electricity. But the sparks grow gradually weaker and weaker, the more the Electricity encreases, in the other rod: At length they quite cease, when the Electricity is therein as strong as in the first. And would you instantly experience the truth of this, lay at the same time with the first rod a rope on the glass, and sling it, by means of a silk string on a stand in such a curve manner, as to be quite distant from the first rod, and with its end to touch the other. For thus the second will after two or three approaches be as strongly excited as the first: And hence the sparks, which were at first produced, come to cease instantaneously; but to manifest themselves on a sudden, upon touching the other rod with the finger.

71. Also from the glowing iron, that lies on two cold iron rods, which last are excited, and rest on blew silk strings, there issue electrical sparks.

This experiment is mentioned by Professor *Hausen*, in the above-mentioned *Latin* treatise (a).

72. In like manner there arise sparks on excited and melted lead, upon holding a metal against it.

73. Whereas in melted and excited sealing-wax we only hear a rushing noise, upon bringing a metal to it, the wax heaving in the part, where the metal is held, like a pointed drop.

74. The spirit of wine in the thermometer begins to rise, after hanging it for some time by a stand, on or over a tin tube, excited at once, and at no great distance therefrom.

This must be tried in a room, that in the course of the experiment has an uniform degree of warmth: And therefore the thermometer to stand in this room till it have an equal pitch of warmth therewith; as also the persons, who are to perform the experiment. The thermometer also to be so distant from the person, who excites the glass on the machine, as to receive no degree of warmth from him. In a quarter of an hour, that the tin tube is excited by the glass, the height, thro' which the spirit of wine diffuses itself, becomes very observable.

If the thermometer be held against the excited glass, the spirit of wine rises in an instant visibly upwards.

The tin tube, all the time it is excited, acquires no degree of warmth, that may be felt with the hand on its close surface; But in the time of exciting, if you either move the finger, or the mouth towards it, so as to remain at a certain distance therefrom, there is felt a soft motion, which produces on the finger or mouth a gentle warmth.

75. The

(a) §. 6. n. 2. p. 11.

75. The electrical sparks from metals, as iron and silver, kindle fluid matters, which are otherwise capable of being kindled by means of a flame. In particular this experiment easily succeeds upon holding a vegetable quintessence in a tea-spoon under the hilt of an excited sword, whose point is turned towards the exciting glass, fig. 9. This fine spirit is also very easily kindled by the sparks of an excited tin tube.

This experiment, with the sparks of excited metals, was made by Dr. *Ludolph*, Field-Physician to the King of *Prussia*, in the beginning of 1744; when by the friction of a glass tube, he, in the presence of several hundred persons, kindled the ætherial liquor of *Frobenius*.

76. A glowing iron causes no flame in any spirit, whether the iron be held quite close to, or at the distance of a few lines from it; but if excited, its electrical sparks instantaneously kindle any fine spirit (§. 71.)

77. The sparks, which issue from an excited Man, set on fire a spirit, even as quick as the sparks of an excited metal, whether the Man be excited either immediately by the glass of the machine, or by means of a tin tube.

This experiment I made on myself, on occasion of shewing some Electrical Experiments to the celebrated Professor *Wolf* of *Hall*: For at that time, neither any one in the company, nor I myself knew, that the sparks, which arise from an excited Man, were capable of kindling, or setting spirits on fire. But in regard the sparks of an iron tube, which was full of rust, had set on fire the vegetable quintessence with an extraordinary quickness; one of the company took occasion thence, to ask, whether the sparks of an excited Man would not have the same effect? I therefore stepped directly upon a square frame, strung with blue silk strings, and laying hold with one hand on the rusty tube, I held the fingers of the other hand over the quintessence. The sparks of the finger fell so plentifully into the silver spoon, that the essence was in an instant set on fire. The more unexpected this appearance, the greater matter of surprise and satisfaction it yielded the company. (fig. 12.)

78. Dead pullets, pork, raw and boiled veal may be excited in such a manner on a tin tube, or in the hand of a Man, that the sparks proceeding from the flesh shall also kindle the vegetable quintessence.

79. When the liquors, which bear being kindled by the flame, happen not to be quite fine, you need only warm either the spoon, wherein you put them, or previously kindle the liquor, and again extinguish it, before you approach it to the excited body.

Thus I have with electrical sparks set on fire camphorated spirit of wine, spirit of wine tinged with saffron, the common vegetable essence, dulcified spirit of nitre, nay *French* brandy and corn spirits, after being previously warmed a little.

If you would kindle oil, pitch and sealing-wax by means of the electrical sparks; these substances must be heated to a degree, nearly approaching accension.

80. One sort of glass bears the being excited by rubbing, in a quicker and stronger manner than another. Among those made in *Germany*, I have found the white streaky sort, peculiarly proper for the purpose. Of two glasses, which in substance are of equal goodness, but which differ in thickness and size, the thinner and smaller is sooner and more strongly excited than the other. But above all things, the glass, intended to be excited, is to be dry, and the cushion neither to have any wet.

81. It was mentioned above (§. 42.) how electricity may be remarkably propagated in wet silk; and tho' but moderately wet, the electricity of a body resting thereon proves weaker than otherwise it would.

82. And thus the air, abounding in moist vapours, so as to wet either the blue silk strings, on which the bodies lie or stand; or the glass, which is rubbed; or the leather, wherewith it is rubbed, will make the electricity not to be of its usual strength: And in these circumstances it may be said, that at times the weather proves an impediment to Electricity.

83. When an excited body rests upon blue silk strings, its electricity extends all around it to a good distance: But upon so near an approach of other bodies, which propagate electricity, as to be within its sphere, the body comes to share something of its force to these other bodies.

84. Neither the original nor propagated Electricity is interrupted by the motion of the air, whether the excited body be exposed to the wind, or to the blast of a pair of bellows or of the mouth. I have sometimes caused four or more persons blow with their mouths against an excited rod, and even with bellows, without ever observing that the electricity was weakened thereby.

But should a moist wind, or the breath of the mouth, wet the blew silk strings, on which the rod or other body rests, the Electricity becomes thereby diminished, so, as to propagate itself in the stand, and from that, farther.

85. I could never, by means of the glass on the machine, communicate any Electricity, to the iron, wherewith a magnet had been long armed or capp'd, tho' laid on blew silk strings, so as to excite sparks, which are otherwise no uncommon thing in iron.

86. But if this magnetic iron be held against an excited tube of iron plate, which is impregnated with no magnetic virtue, there arise sparks of no inconsiderable force.

87. Nay the naked magnet becomes but slightly excited, if the glass immediately communicate the Electricity thereto.

88. But if either a naked magnet, its capping alone, or a capped magnet, be suspended by a tube of iron plate, so as to be in immediate contact there-

with, these bodies acquire so strong a degree of Electricity, as that the issuing sparks shall visibly set on fire the vegetable quintessence.

89. There would still remain various experiments to be made; as whether the electricity of the glass on the machine would be weakened upon exciting a magnet upon it for some hours together. This I have tried twice, and each time observed a certain degree of weakness; which I not only sensibly perceiv'd in the act of exciting, but also some time after I had begun a new to excite the tin tube with the foregoing glass. In order to discover to what this might be owing, I made the experiment with the globe, which Professor *Hausen* otherwise employed for exciting Electricity; and the Electricity immediately shewed itself in its greatest strength: I therefore directly put another glass to my machine, and being rubbed a number of times, we came to perceive a great degree of Electricity. I at length removed the blue silk strings, on which the excited magnet had lain, and stretched others over the stand, which had lain in the same room, wherein those removed had stood. In an instant, upon moving the glass, the Electricity manifested itself in its due degree of strength, and the sparks issuing out of the tin tube, set spirits on fire.

With this new glass I excited the day following the magnet again for some hours successively; and again I observed a decrease of Electricity: After this I let the glass rest, that it might fully cool: In some hours after I begin anew to excite the tin tube and the sword therewith: But the effect was so weak, that the sparks were quite unfit to kindle any spirit. Upon this I left the glass to stand for 24 hours; but afterwards attempting to excite therewith, the Electricity it communicated to the sword and tin tube, was still unable to kindle the quintessence; so that I took a second time a new glass, and strung the stand again with a set of new strings, when immediately the desired effect ensued.

But after suffering both these glasses to stand a few days, they again come to be capable of sufficiently communicating Electricity to bodies, which lie sufficiently near them.

Yet from both these remarks I would not have a general proposition drawn, as if the magnetic virtue impeded or weakened the communication of the Electricity.

90. The Electricity excited by the glass immediately in the flesh is by much weaker than that, which the flesh receives from an excited tube of iron plate, or from an excited man.

By the former I have not been able to kindle the vegetable quintessence. I will not say, that it is absolutely impossible, only the making the experiment would take up too much time: On the contrary, the other Electricity, which the flesh acquired from an excited man, or tube, set the quintessence in an instant on fire by its sparks.

91. Whereas men, swords, and tubes of iron plate acquire from the excited glass so strong a degree of Electricity, as to set on fire all manner of spirits indiscriminately.

92. But if those bodies happen to be excited by help of a rope, which is immediatly excited by the glass, the sparks prove very weak; and sometimes I have not been able therewith to kindle the vegetable quintessence.

93. But if the rope be excited by the tin tube, which lies near the excited glass, it communicates to a sword such a degree of electricity, as that the sparks in an instant light up the vegetable quintessence.

94. A dry sponge, at an excited sword, or an excited tube of iron plate, gives forth no sparks: but drenched with water, gives sparks, which are often pretty strong; tho' sometimes I have not been able to kindle with them.

95. In like manner, the Electricity, which is propagated from the flame of an excited candle, into a tin tube, is not of a degree of strength, to yield kindling sparks.

96. Upon cementing with wax a piece of wooden board on a beer-glass, wherein are leaf-gold or sand-corns, on a small stand; or upon doing over a glass cylinder, in which also the like light bodies lie on a stand, either with dry paper, or with white and dry linen, or black and dry gawze, and holding an excited glass tube over it, the subjacent small bodies are in an instant made to skip and frisk about. But if the wood, paper, linen, gawze, be thoroughly wetted, 'tis impossible with the glass tube, never so strongly excited, to cause such frisking motions in these small bodies: whereas, if the glass cylinder, on which the wet wood is cemented, or other wet thing lies, be placed on a blue-silk net, strung over a square frame; and the stand, whereon the leaf-gold lies, be set on the table, under the frame, so as to pass quite thro' the net, and in the cylinder be at such a distance from its sides, as to have little or none of its electricity communicated; the leaf-gold begins to frisk and skip about, each time the excited glass tube is passed over the wet wood, the wet paper, the wet linen and the wet gawze.

97. When a tube of iron-plate, or a sword, is excited at both ends at once by two glasses; the communicated electricity operates stronger, than if it only arose from one excited glass: The encreased degree of strength manifests itself both by the electrical sparks, and by the bending of the water-flash, passing out of a siphon or crane over the tube: For the sparks prove longer, strike more violently, and sooner kindle: And the water-flash is, at some distance from the tube, bent towards it; which otherwise happens not, if only one glass be employ'd to excite electricity.

98. The propagation of electricity is so quick, as not only by far to exceed the flash of kindled powder, but also the motion of a bullet, which in a second passes thro' a length of 600 foot.

The experiments, whereby I discovered this, are as follows. I laid on the blue silk strings on the stand, Fig. 14. an iron rod, seven ells long,
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and to one end thereof suspended a thread. Near the other end I planted myself on the blue silk net of a square frame, exciting one hand at the glass of the machine: Upon this, I held a finger of the other hand towards the iron rod; and no sooner did the sparks burst out between the finger and the rod, than the thread at the other end was moved.

Upon this, I trailed along a hempen rope of 60 ells in length out of the room, where the machine was, thro' a hall, and out of this, into another room, and back again to the first room: The rope moved along blue silk strings suspended atop the doors: Both the ends of the rope were in the room removed some ells asunder. On the one end I caused a person stand with a glass roundle, on which there lay leaf-gold: Near the other end I myself stood upon the blue silk net of a square frame, holding one hand towards the glass of the machine: After I was excited, I with the other hand laid fast hold on the rope; no sooner was this done, than the leaf-gold on the glass roundle at the other end of the rope began to skip and frisk; and scarce was there any space of time observable betwixt the touching the rope, and the leaf-gold's beginning thus to skip.

99. The electrical sparks are with as great velocity propagated to bodies, as electricity in general; and prove as strong in the part, where they cease, as where they begin.

This appears by several experiments: If, for instance, you press the finger against the end of an iron rod, that rests on blue silk strings; so soon as an excited man either holds his finger, or an excited piece of metal against the other end of the rod, so that sparks shall arise, a violent pricking is felt in the pressed hand: If the rod be pressed against the cloaths, so as these shall be made to lie close to the body, the pricking will be felt each time very violent and quick, on each part, on which the rod presses.

This sensation is felt more violent still on the head: I have sometimes taken up an iron hammer with the wooden handle, and pressing hard its flat part against the forehead, have held its narrow or sharp side against an excited tube of iron-plate, at the distance, that sparks are produced at: When such sparks arise, one imagines, they pass thro' the middle of the hammer, and that the stroke of the sparks goes in a straight line through the hammer and the whole head; and this stroke is also so violent, as to make the head quake; so that I was apprehensive, the often repeating this experiment might possibly hurt the brain: If you apply the hammer to the teeth or gums, the stroke does in like manner prove so twinging, as that one would not chuse to feel it often.

100. Electricity may be propagated thro' glass, and put into motion light bodies in vacuo, equally as in the free air.

If you lay on a small stand on the plate of an air-pump a glass roundle with leaf-gold, and a glass bell or receiver over all; after the air is quite exhausted, let a glass tube be rubbed and held on, or over the bell;

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at each stroke of rubbing the tube, the leaf-gold under the bell is put into electrical motions.

If the glass of the bell happen to be something thick, it may be previously warmed with a warm cloth.

101. I have put into balls, such as those on Thermometers, some grains of sand, and hermetically sealed the short tube of the ball, after the air has been forced out by the heat. Now, whether I hold those balls either against an excited glass tube, or an excited metal, the sand-corns remain still motionless therein.

They also remain without motion, tho' the balls are open at the points and consequently full of air.

102. If you rub a narrow and exhausted glass-tube between the fingers ; or if you lay the hand on an exhausted glass globe, turned round with a wheel, or rub the globe on a leather cushion on the lathe, there is within-side produced a light, almost filling the whole glass tube, and diffusing itself out in various parts of the globe.

103. But there is also produced without-side the exhausted globe a light, upon holding a body, as for instance, a finger or piece of metal against it.

104. If an exhausted glass cylinder, which is some inches in diameter, be brought towards an excited tube of iron plate, there arises on its inward surface a number of rays, flashing up and down like lightening, and diffusing themselves internally about the whole cylinder.

If this experiment be made with a small globe or ball, having a narrow tube, hermetically sealed over the fire, after the air is expelled by the heat ; the whole ball will be internally enlightened, and its tube so filled with light, that when held to the excited tin tube, the light shall seem to flow like a stream.

This stream becomes still more sensible, if there is some quicksilver in the exhausted ball

I have caused to bend a narrow glass tube in such a manner, as that the figure has represented the first letters of ones name ; I also put some quicksilver into it, and expelled the air by means of fire, and then sealed the tube with a view, by thus producing the electrical light in the bent tube, of representing the letters in the dark : Yet I could not then succeed, as probably the air was not quite expelled, or the tube was too narrow ; and my affairs have not hitherto allowed me to repeat the experiment.

105. 's*Gravesand* describes a machine, by means of which, a glass globe may be rubbed in vacuo with a cloth ; and if this rubbing be performed in the dark, there is a light observed on the globe. A machine should also be devised where all the experiments, which are now done in the open air, might be performed in vacuo.

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An Account of a Whirlwind that happened in Möklinta, a Parish in Westmannia, on the 27th of September, 1725. By M. Eric Kallénus. From the Acta Literaria Sueciæ Trimestre 4. Ann. 1725. p. 106.

Translated from the LATIN.

ON the 27th of *September* last past, near two in the afternoon, as M. *Kalsenius* had, after dinner, got upon the top of a sandy rising ground near the Bishop of *Möklinta*'s house, and the clouds, which were scattered here and there over the face of the heavens (for a rain which had lasted, without intermission, for some time, ceased a little before noon) seemed at length to gather together in order to a shower: At first a kind of indistinct noise or murmuring was heard as it were, at a distance; which, tho' it seemed to him to be something uncommon, as a gentle wind blew from the west; yet suspecting that nothing more remarkable would arise from so trivial a matter, he returned home and went in to his own chamber. But upon his coming out again immediately, a great rumbling noise, like that of a very rapid river, filled the whole air. Upon looking about for the cause of this phenomenon, he observed, that something like smoke came from the west, that was divided into several balls, which moved round very swiftly, and poured down into his area, a great quantity of water. not like drops of rain, but whole pailfuls as it were.

At which being not a little surprised, and not being sure what the matter was, he went in again; but had scarce been gone so far as to look thro' the window, when he saw the thatch of a certain granary, all of a sudden, raised aloft, as if torn off with hands, and the wooden spars for keeping on the thatch, tho' pretty large and heavy, on account of the continual rain, carried like feathers thro' the air. A large gate newly put up, with its roof and thick strong posts of firr, and some of the roofing next the gate was broken in pieces, and, what will seem remarkable thrown to the part opposite to that from which the wind blew. A strong chimney was thrown down, and the tiles scattered about; the boards and laths upon the smaller houses were torn off and broken; moreover, the whole air was all of a sudden filled with thatch, laths, and every thing else that could not withstand the violence of the storm.

As soon as the tempest abated, M. *Kalsenius* went out, in order to view more accurately this sudden desolation, when he met one of his servant-maids, who happened to be abroad about some business without the village, who, as she wanted to go thro' the gate that was thrown down, as has been said, was suddenly seized by the Whirlwind, which carrying her up into the air so as not to touch the ground, the distance of 15 or 20 fathoms,

fathoms, laid her down on the top of a rising ground, where tho' she caught hold of the rock, she had much ado to withstand the violence of the storm. Then we found that all the hedges, thro' which the Whirlwind had taken its course, for the space of 40 or 50 fathoms in breadth, were broken and strewed here and there over the fields; and we observed, that the new and strong laths were not only carried two stones throw, but split as with an ax, and broken in several places, nay, and driven into the top of the rising ground a foot deep.

Next M. *Kalsenius* carefully enquired, where, and in what manner this Whirlwind first appeared; of which he had different accounts from different persons, yet almost all agreed in this, that a thick smoke was observed to arise from the neck of land which stretches out into the neighbouring lake, and is about the eighth part of a mile from where M. *Kalsenius* lived, and that presently the Whirlwind was carried thither with so much impetuosity along one arm of the lake, as to carry up into the air such a great quantity of water, and the lake seemed to rise up in walls, as it were, as is evident from Scripture was the case with the river *Jordan*; and hence doubtless did these waters rise, which did so plentifully overflow the village.

To the east, this Whirlwind did no less damage; for a wood, which stood in its way, was for the most part pulled up by the roots, and levelled to the ground. In the mean time, the Whirlwind gradually mounted up in the air; so that about half a mile from the village, it was observed to carry along with it boards, laths, beech-bark, with which the houses are thatched, besides other substances, which soon after fell into the neighbouring lake. But what seems most remarkable is, that the thick cloud or smoke, which had spread a disagreeable stench, immediately settled over the lake.

After all this, it began again to rain plentifully, and continued so next day.

*The eating of Spiders without any ill effect. From Sir Sim. Schol-
zius, Misc. Curios. Ann 2d. Obs. X.*

I Knew a young *Scotchman*, a Student at *Leyden*, who eat spiders continually, without any ill consequence: he hunted them out in every corner of the house, and affirm'd they were very delicious food. He had a pale countenance indeed, and seemed a little bloated under the eyes, but was otherwise healthy.

Borelli takes notice of the innoxious comestion of spiders (a). An idiot

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(a) Cent. 3. Obs. 19.

at *Padua* eat both them and scorpions without damage, and *Offredus* saw a beggar at *Orleans* devouring spiders, and other filthy ill-looking animals without detriment (*b*).

Strange Idiosyn crasies. From Dr. Sim. Scholzius, Misc. Curios Ann. 2d. Obs. XI.

A German student, who was my fellow-boarder at *Leyden*, eat apples and eggs familiarly, raw or dressed; he cou'd handle and see them lie on a table, without the least disturbance: but if any one stirred them, it was wholly insupportable to him, he could not look at them; but was seized with a total fainting and swoon, which the famous Dr. *Witte*, of *Riga* in *Livonia*, and my countryman *Scholzius*, who were also my fellow-boarders then, as well as my landlady and her son, with others, were witnesses of, and of the entire reality both of this and the preceding history. I observed something like this at *Elbing* in a clergyman, an intimate friend of mine, who cou'd not eat, nor even behold a pig stuffed and roasted with the head and feet on, as they dress it in *Prussia*, without swooning, but after the head was removed, he could even eat of the pig without difficulty.

Short Reflections on the Plague; and particularly on its rise and cure. By Dr. John Kanold. From the Breslaw Collection.

Translated from the HIGH-DUTCH.

THE Plague seems to arise not so much from any inbred defect or corruption of the air, or from a bad diet, as solely from contagion, or the communication of the pestilential matter; in the same manner as the venereal disease; tho' it is not to be denied, but that the weather may greatly influence its raging and spread. For from undoubted testimonies it is evident. (1) That the Plague in most parts of *Christendom*, is constantly wont to take its rise from the east, and particularly *Turkey*. (2) That this calamity is peculiar to the east, especially *Turkey*. (3) That it is communicated thence, partly by infected persons, and partly by infected goods, especially those tainted with the miasmata and recrements of infected persons; by land, to *Hungary* and *Poland*; and by water, to *Italy*, *France*, *Spain*, *Holland*, *England*, (as was the case in 1663, by means of cotton from *Turkey*) and other maritime places, by the way of an actual, material ferment. Yet (4) that all this happens by a particular direction of the divine providence, at one time preferably to another; partly the various

(b) *Job. Rhod Cent. 3. Obs. 19.*

various co-operation and predisposition of the seasons of the year; and partly, negligence, self-interest, malice and other circumstances, now at this, anon at another time, bringing forth this contagion from its native soil into foreign countries: Whence those constantly engaged in commerce with *Turky*, especially the *Venetians*, have come to this salutary resolution, not only to constitute a standing Council of health, but order all ships from the *Levant* to perform a shorter or longer Quarantine, before ever they shall venture a-shore. However (5.) this holds true, that the Plague in its original must needs have a spontaneous, material cause, even without any derived Contagion; possibly exerting itself as little, as among us does the cause of Petechial fevers; which not every year, but after a shorter or longer period, thro' the means of a peculiar disposition of our bodies, and the weather, originally take their first rise amongst us. What *Helmont** remarks; namely, that the plague recurs oftener now than formerly it did, holds very true; and that not only in *Christendom*, but in the East itself; here, on the score of the Mahometan doctrine of fate; there, by means of the frequent intercourse at this day maintained with the *Turkish* Provinces: Two circumstances that formerly did not take place; whence then the plague could not produce such repeated and wide-desolating ravage, as it usually does at this day. But where and whence this pestilential material Cause had formerly first derived, and still at this day derives its original, remains still a question; especially as little attention has been bestowed on such Origination, the universal or common causes barely, yet, without grounds, being regarded and stuck to; tho' at present several learned Physicians have been forced in general to own, that the plague is by contagion communicated from the East to *Europe*. To me it seems highly probable, that the Plague principally takes its material rise in *Egypt*, and other, either neighbouring or distant countries, alike disposed therewith, by means of a peculiar action of the climate, air and weather, on vitiated and corrupted bodies: And indeed either it usually takes birth from that native distemper, proper to the *Egyptians*, called *Dem el muya*, which in a few hours carries off several persons, and is accompanied with vomitings, anxiety, excessive heat, violent thirst, phrensy, disquietude, corrupted stools, and other symptoms common to the plague, especially tumours, and those subsiding again: Or it is bred of itself immediately from the excessive drying heat of the climate, and from the *Nile* water corrupting in pits and cisterns, and the nasty manner of living of the poorer sort near canals, full of stinking water.

The grand mistake in the several Methods of cure hitherto used for this calamity, is the neglecting to second and promote the efforts of nature: Her usual way is to expel, with the soonest, any noxious recrements, received into the body by outlets proportioned thereto; as by sweat, urine, stool, &c. The same procedure of nature we also observe in the plague, whilst

* Tract. de Peste. c. 4.

whilst commonly she attempts the discharging the unknown and highly deleterious ferment or poison by buboes in the groin, armpits, and behind the ears; or failing in this, by carbuncles; that is, gangren'd, nay sphacelated abscesses. Of such pestilential excretions we find innumerable instances in the several cases and observations that are handed down to us; but which thro' the prejudice of System and Authority have not been considered in that light evidence would seem to claim.

The history of all ages shews, 1. That the plague has been always accompanied with tumours and carbuncles. 2. That such excretions prove the surest and best relief; almost all those, who have had such excretions, having recovered. 3. That the miscarriage of other Patients was owing to such excretions either happening too late, being insufficient, or appearing not at all, or being accompanied with other disorderly motions and excretions.

Notwithstanding these evident truths, such excretions have barely been considered as symptomatical; and consequently their treatment thrown over on manual Operations; and the internal and capital cure directed to promote and excite sweating, and by no means the excretions, pointed at by nature.

Tho' an appropriated specific for promoting such excretions be not hitherto known; yet from diligently considering the nature of the humours, to be excreted, the organ and the medicines, it may not be a thing impossible to light on some one, that shall serve to promote the expulsion of pestilential abscesses; as we are not without specifics in other diseases with eruptions.

F I N I S.

